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Baron von Weber's Experiments on the Stability of Permanent Way.

[CONCLUDED FROM PAGE 410.]

We now come to the deductions drawn by Baron von Weber from the results of the various series of experiments recorded by us in the preceding articles of the present series. It is the opinion of the Baron that the tendency of advanced railway practice is to abandon the ordinary system of iron or steel rails fixed on wooden sleepers for the use of permanent way structures formed of iron alone, and he considers that ultimately lines of rails will be constructed as continuous girders, strong enough to resist all the actions of the rolling stock, and resting directly upon properly prepared ground, without the intervention of intermediate members or perishable materials. "Looking back," he says, "upon the experimental researches, we are struck by an extraordinary fact, the remarkable character of which is enhanced by the circumstance that it has been little known and still less taken into consideration. This fact is that heavy trains and powerful engines have already run longer than the age of the present generation upon lines or structures the flexibility of which is so great that every wheel leaves its impression, and every oscillation produces a displacement; and of which the stability—as far as it depends upon the resisting power of its mechanical parts—is so small in proportion to the disturbing influences brought to bear upon it, that almost any one of these influences would destroy the structure if it were not that the very load itself increased the stability, through the agency of the friction between the wheels and rails. It would be quite unworthy of engineers and engineering science to reply that, as the traffic has for a long period been satisfactorily carried on lines possessing such great flexibility, that, therefore, it is of no importance whence the stability comes, so long as it is there when required. We might as well state that the neighborhood of a certain powder-mill is free from danger, because explosions have occurred but rarely during the last five-and-thirty years."

With these observations we, in the main, concur, although we must add that the "continuous girder" permanent way of the future has yet to be produced in a practical form. We quite agree with Baron von Weber in considering that that portion of the stability of a permanent way due to the friction between the rails and wheels is a most treacherous thing to rely upon, and, in fact, some of the experimental investigations have proved that this friction is not always present when wanted. This is a point upon which we shall have more to say directly, when we give an account of Baron von Weber's investigations of the variation which takes place in the load upon the wheels of an engine when running; but we may remark here that experiments have shown that the load upon one point of a structure may almost entirely disappear whilst it is being traversed by a heavy engine, and that the structure may then be exposed to displacing forces which the mechanical details of the structure are totally unfitted to resist. It is under such circumstances as these that there have undoubtedly occurred many accidents for which sufficient causes have never been discovered. In fact, Baron von Weber considers that no combination of iron or steel rails with wooden sleepers, which has hitherto been devised, possesses, from its mechanical structure, sufficient resisting power to enable it to withstand, without the aid of the friction between the wheels and rails, the disturbing forces to which it is liable to be exposed, and it is for this reason that he anticipates, as we have already stated, the ultimate adoption of some class of continuous girder permanent way.

BARON VON WEBER'S EXPERIMENTS ON THE VARIATION IN THE LOADS ON THE AXLES OF LOCOMOTIVE ENGINES.

It is evidently of the utmost importance in investigations concerning the stability of permanent-way structures, to obtain precise information as to the nature and amounts of the disturbing forces to which such structures are exposed during the passage of rolling stock over them. The forces which act upon permanent-way structures are of two kinds, namely, first those due to the pressure of stationary loads upon the rails at different points—and nothing is easier than to determine the influence of such loads upon the structure subjected to them—and, second, to those due to the action of vehicles in motion. These last-mentioned forces are the most important; but they are of such a complicated nature that any attempt to ascertain their amount theoretically must necessarily be worthless, while a *complete* experimental investigation of them has never been carried out, although, as we shall show presently, Baron von Weber has determined many interesting facts concerning them.

The forces exerted by the rolling stock upon the rails are, as has been already mentioned, of three kinds, namely: 1st, those which tend to produce a horizontal displacement of the structure; 2d, those which tend to cant the rails; and, 3d, those which produce a vertical deflection of the rails. Baron von Weber's extensive experimental researches on the stability of permanent way, of which we have already given an account, have shown clearly that the friction between the wheels and rails, and that between the different parts of a loaded structure, form the most important elements of stability in such a structure when put together in the ordinary manner; and we may repeat here the assertion already made, that if there occurs such a vertical oscillation of a rolling vehicle as to relieve the rails of their load to a greater or less extent just at the time they are exposed to the action of a force acting laterally, the structure must certainly be loosened, or some other disturbance be caused.

In order to simplify the investigations of the disturbing forces due to the rolling load, Baron von Weber confined his researches to the action of locomotives, as being the heaviest vehicles running on a line, and as having their masses concentrated so as to produce generally maximum effects, although it is well known that under certain circumstances vehicles which load the permanent way with a less weight per foot run than a locomotive, will produce even a greater effect on the permanent way. Baron von Weber enumerates long eight-wheeled goods wagons with trucks with very short wheel bases, and tenders of certain kinds with very high centers of gravity, as being amongst the classes of rolling stock just alluded to. The accurate determination, experimentally, of the amount of the horizontal forces exerted by the wheels of locomotives on entering curves, or passing through switches or sidings, is attended with very great difficulties and considerable expense; and Baron von Weber states that after making some unsuccessful trials in that direction, he was obliged to give the matter up. He, however, strongly urges the advantages which would result from the carrying out of such investigations by those having the opportunity of doing so, and he suggests that approximate results, at least, might be obtained by taking an inside cylinder engine, making the axle bearings so as to permit of lateral play, and controlling the end motion of the axles by strong springs secured to the frames, and arranged to press against the axle centers. By employing suitable apparatus to register the maximum deflections of these controlling springs, an idea might be obtained of the amount of the lateral forces exerted by the engine upon the wheels, and consequently by the latter upon the rails. The controlling springs would necessarily, we may add, have to be very rigid, or their deflection would materially affect the amount of the disturbing forces.

Baron von Weber, however, had not the opportunity of fitting up an engine in the manner just described, and he therefore confined his researches to ascertaining the extent to which the loads upon the wheels of an engine are modified by the vertical oscillations of the latter. A knowledge of the maximum loads imposed by these oscillations is of importance in determining the proper dimensions of rails, etc.; but of still greater importance is a knowledge of the amount to which such loads are reduced, as by such knowledge we are informed of the extent to which the co-operation of the friction between the rails and wheels, etc., may be depended upon for increasing the stability of the structure.

The bearing springs of locomotives form the most convenient apparatus which could be employed for carrying out such investigations as those just mentioned, and Baron von Weber availed himself of them in the following manner: Six six-wheeled locomotives—five of which had each two pairs of coupled wheels 5 feet in diameter, whilst the sixth, which was an express engine, had a single pair of driving wheels 6 feet in diameter—were loaded with the necessary water and fuel; and after they had been carefully adjusted, they were placed upon an exactly level portion of the line, and the load upon each wheel was carefully ascertained by means of Ehrhardt's weighing machine. To the frames of these engines, above the leading and trailing springs, were secured strong elastic steel scrapers, which were provided with hardened edges, 4-5 in. wide, bearing against plates fastened to the spring boxes. The positions of the edges of these scrapers upon the plates for the normal state of each engine were exactly marked upon the plates, and these marks of course indicated the variations of the loads on the respective axles, marks above

Fig. 1.

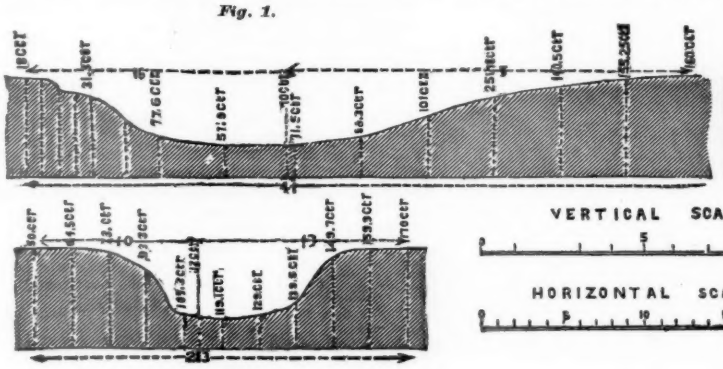


Fig. 3.

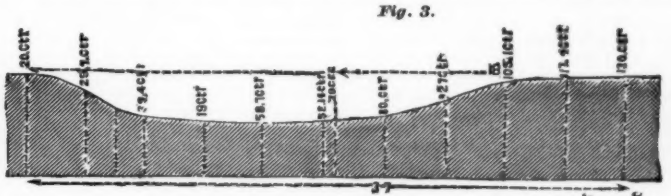


Fig. 2.

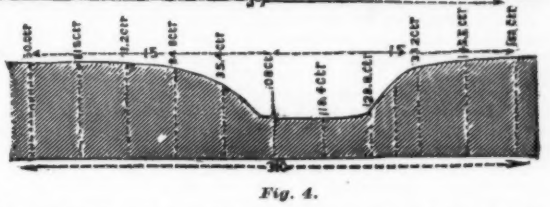


Fig. 4.

TABLE SHOWING THE VARIATIONS IN THE LOADS ON THE AXLES OF LOCOMOTIVE ENGINES.

Reference Numbers.	Names and classes of engines.	Name of railway on which the engines run.	Normal load on the axles.				Springs on which the experiments were made.	Length of springs.	Normal load and camber of spring tested.		Results of the observations.							
			On leading axle.	On central axle.	On trailing axle.	Total weight of engine.			Load.	Camber	Maximum load.		Minimum load.		Differences.			
											Maximum load on spring	Camber of spring under maximum load	Minimum load on spring	Camber of spring under minimum load	Difference between maximum and minimum loads.	Difference between maximum and minimum camber		
			cntnrs. tns.	cntnrs. tns.	cntnrs. tns.	cntnrs tns		mil. in.	cntnrs tns	mil. in.	cntnrs tns	mil. in.	cntnrs tns	mil. in.	cntnrs tns	mil. in.		
1	"Ceres."—Six-wheeled engine for mixed traffic; all the three axles in front of the fire-box; four-coupled wheels 5 ft. in diameter; cylinders 16 in. in diameter by 24 in. stroke; pressure of steam 100 lbs. per square inch.	Dresden-Gorlitz.	152.4—7.72	222.6—11.27	223.0—11.24	579—30.23	Leading Trailing	900—35.43 900—35.43	70—3.54 112—5.67	37—1.46 63—2.68	160—8.1 470—8.61	12—0.47 55—2.16	18=0.91 50=2.53	53=2.08 78=3.07	142=7.19 120=6.08	41=1.62 23=0.91		
2	"Tellus."	Dresden-Gorlitz.	do.	do.	do.	143—7.24	220—11.13	221.—11.23	584—29.6	Leading Trailing	900—35.43 900—35.43	70—3.54 108—5.47	32—1.26 32—1.26	130—6.53 160—8.1	14—0.55 17—0.67	20—1.01 50—2.53	51=2.01 47=1.85	110=5.57 110=5.57	37=1.46 30=1.18
3	"Vulkan."	Dresden-Bodenbach.	do.	do.	do.	160—8.1	257.6—13.04	242.4—12.27	660—33.41	Leading Trailing	900—35.43 900—35.43	78—3.95 115—5.82	27—1.06 71—2.79	160—8.1 200—10.13	7—0.27 54—2.12	10—0.51 50—2.53	51=2.01 88=3.46	150=7.60 150=7.60	44=1.74 34=1.34
4	"Mandau."	Lobau-Reichenberg	do.	do.	do.	143.4—7.26	240.—12.15	235.6—11.93	619—31.34	Leading Trailing	900—35.43 900—35.43	72—3.65 117—5.92	39—1.53 43—1.69	150—7.60 165—8.36	17—0.67 29—1.14	5—0.25 50—2.53	62—2.44 58—2.28	145=7.35 115=5.82	45=1.77 29=1.14
5	"Ehrenstein."	Lobau-Reichenberg	do.	do.	do.	155—7.85	224.—11.34	229—11.60	608—30.79	Leading Trailing	900—35.43 900—35.43	78—3.95 114—5.77	53—2.09 39—1.53	140—7.09 180—9.1	35—1.38 25—0.98	45—2.28 30—1.52	66—2.60 58—2.28	95=4.81 150=7.60	31=1.22 33=1.30
6	"Prometheus."—Six-wheeled engine for fast passenger traffic, with single pair of driving wheels 6 ft. in diameter, and trailing axle behind the fire-box; cylinders 15 in. in diameter with 22 in. stroke; pressure of steam 100 lbs. per square inch.	Dresden-bodenbach.	205.4—10.4	261.4—13.44	88.2—4.47	559—28.31	Leading Trailing	900—35.43 900—35.43	95—5.01 135—6.84	20—0.79 21—0.83	175—8.86 160—8.1	0—0. 16—0.63	80—1.72 105—5.32	45—1.77 29—1.14	145=7.34 55=2.78	45=1.77 13=0.51		

NOTE.—The springs used were each composed of nine plates 90 millimeters (=3.5) wide, with the exception of those of engines 4 and 6, in which cases the plates were 95 millimeters (=3.74) in width.

the zero points in each plate indicating a reduction in the load on the corresponding spring, and marks below the zero points an increase in this load above that which existed in the normal state of the engine.

The extreme marks upon the plates above and below the zero points showed, therefore, the extent to which the springs had been compressed under the greatest and least loads respectively; and the scrapers being left in action for a whole month, during which time the engines were employed in their ordinary service, the plates at the end of this time formed registers of the maximum and minimum deflections of the springs during the months' running. At the end of the time we have mentioned, the springs were taken off the engines and placed under a lever press, and by this means, of course, the exact amount of pressure requisite to produce the deflections registered could be accurately ascertained. This pressure, in each case, *plus* the weight of the wheel and axle, is taken by Baron von Weber as the force acting upon the rail at the moment when the corresponding mark is upon the plate. We may remark, however, that to some slight extent the pressure upon the rails would in reality differ from that indicated by the deflection of the springs, the difference being due to the inertia of the wheels and axles. The differences due to this cause would be greatest with an engine traveling at a high speed over a very flexible permanent way; but it would be very difficult to estimate their amount with any degree of accuracy, and Baron von Weber, as we have said, disregards them altogether. The results of the Baron's observations, as recorded by him, are given in the table.*

From this table, Baron von Weber makes a series of deductions which are worthy of the careful attention of both locomotive superintendents and engineers in charge of permanent way. These deductions are, in substance, as follows:

1. That, as is well known, six-wheeled locomotives, when running, oscillate† round their central axle, a dipping or plunging motion taking place towards the leading and trailing end, alternately. Thus the loads upon the leading and trailing springs vary according to the oscillations, and consequently the pressures exerted by the leading and trailing wheels upon the rails vary also.

2. That in the case of the engines on which the experiments were made, the greatest load imposed in this manner upon the springs exceeded the normal load by 103 per cent. (the increase of load being from 70 to 160 centners per wheel) in the case of the leading springs, and by 74 per cent. (the increase being from 115 to 200 centners per wheel) in the case of the trailing springs.

3. That the maximum loads just mentioned are much greater than that laid down by the rules acknowledged by German railways, namely, a maximum of 130 centners per wheel. Thus, in determing the strength of permanent-way structures, this great increase of the pressure sometimes exercised upon the rails should be taken into consideration.

4. That the load upon the springs is sometimes reduced during the running of the engine to about 7 per cent. of the normal load (the reduction being from 72 to 5 centners) in the case of the leading springs; and to 26 per cent. of the normal load (from 114 to 30 centners) in the case of the trailing springs. The decrease, or even, sometimes, the almost entire removal of the load from the leading springs, is surprising. The experiments, of which an account has just been given, prove that the permanent way is momentarily subjected to far greater loads than it is ordinarily supposed to carry, and further, that it is sometimes almost entirely relieved of its load, as above stated. It appears also certain that there exist horizontal oscillations of the vehicles, produced at first by partially vertical oscillations, and there thus exists the greatest possibility of the coincidence of such a relief from load as has just been mentioned, with a horizontal oscillation towards the rail from which the load has thus been removed, the result being a displacement of the permanent way, as, under the circumstances supposed, the opposition offered by the latter is but that due to its mechanical structure. The experiments on the stability of permanent way already described, together with the investigations of the variations of load on the wheels of the engines, explain, in a satisfactory manner, the causes of many cases of widening of the gauge and displacement of the structure, previously considered inexplicable.

5. The difference between the maximum and minimum loads resting at different times on the same spring, varies by more than double the normal load in the case of the leading wheels; but seldom by more than 40 per cent. of that load in the case of the trailing wheels, a circumstance which indicates that the real center of oscillation of the masses forming the engine is situated between the driving and trailing axle, and not over the former.

6. That the extreme amounts of variation in the loads on the leading and trailing springs were found to occur in an engine the construction of which would have least justified the expectation of their taking place. This engine was the "Prometheus," in which the wheel base differed very little from the length of the boiler, and in which about 60 per cent. of the load was removed from the leading wheel, while that on the trailing wheels was reduced to 77 per cent. of the normal load. This fact points strongly to the danger attendant upon placing a great load upon the driving axle, if the latter is situated under the center of the engine.

Such, in substance, are Baron von Weber's deductions from his experiments on the variation of the loads on locomotive axles; and we think that our readers will agree with us in considering them important and suggestive. It is much to be regretted that opportunities did not exist for extending the observations to engines mounted on their wheels in such a manner that the load is practically supported on three points, an arrangement which is now being rapidly acknowledged in this country as the best which can be adopted, and which has long been almost exclusively used in America. The experiments can, however, be carried out in such a simple manner, that we trust that some of our locomotive superintendents will make observations for themselves, and we need scarcely add that we shall be glad to make the results of such observations public, if they are forwarded to us.

It was considered by Baron von Weber—and justly—to be of importance, to obtain an idea of how often the loads upon the springs had varied by certain amounts, and to obtain this information he ingeniously turned to account the forms of the grooves which had been cut by the scrapers in the plates attached to the springs. The scrapers being made of good hardened steel, and being forcibly pressed against the plates, and the latter, moreover, being of thoroughly homogeneous material, the depth at various points of the groove cut by the scrapers into the plates formed a good practical indication of the proportionate frequency of the different variations of load. By the aid of a pantograph the curved outlines of the bottoms of the grooves cut by the scrapers were drawn to an enlarged scale, the vertical scale being made double the longitudinal. A set of these diagrams, taken from the engines "Ceres" and "Tellus," is given by us on the previous page, the vertical scale in our engraving being 5 times, and the horizontal 2½ times, the natural size. Diagrams Figs. 1 and 2 are taken respectively from the leading and trailing springs of the "Ceres," and Figs. 3 and 4 from the leading and trailing springs of the "Tellus."

An inspection of these diagrams shows at once a great difference in the action of the leading and trailing springs, notwithstanding that they are of the same length. Thus, on examining diagram Fig. 1, from the leading spring of the "Ceres," it will be found that most oscillations must have produced a decrease of the load from 70 to 44.6 centners, while a decrease of 25 centners can have been by no means unfrequent. The decrease to 18 centners, however, appears to have happened but a few times. On the other hand, an increase of the load from 70 to 86.3 centners must have been constantly happening, while, from that amount, the gradual and unbroken curve shows that the greater any further increase of load, the more seldom did that increase take place, the maximum load of 160 centners apparently having been imposed but very seldom. In fact, the extreme loads were almost always indicated by but a few scratches.

Turning now to the diagram, Fig. 2, taken from the trailing spring of the "Ceres," we see that the increase of load from 112 to 139.5 centners, must have been as frequent as the decrease of the load from its normal amount to 107 centners. The curve showing the increase of load from 139.5 to 149.7 centners is very steep, and it is evident that the higher increase of load occurred as rarely as the decrease of load, from 112 to between 78 to 50 centners. The diagram from the "Tellus" affords similar evidence, and are equally instructive.

From a consideration of the results of all his experiments on permanent way, and on the variation of the load on locomotive engine axles, Baron von Weber derives the impression that, under present circumstances, there exists on railways a constant danger, which can only be effectually overcome in two ways, namely: First, by adopting such a system of permanent way that the longitudinal rigidity of the structure is sufficient to distribute the load on the rails over a considerable distance, so that the momentary removal of the load from one point may not so reduce the stability of the structure so as to cause danger; and, secondly, by adopting such a system of construction for the vehicles as to prevent the momentary removal of the load from an axle, or at least to reduce the removal of load to such an extent as to avoid danger. Of course the best effects are to be obtained by adopting both these precautions.

The Baron further considers that none of the combinations of rails with timber or iron *cross* sleepers satisfy the conditions above mentioned, and he expresses a preference for Hartwich's system of permanent way as best providing the necessary longitudinal rigidity and stability against horizontal forces. The second condition he considers will never be fulfilled where six-wheeled vehicles are employed, and he further advocates the use of four-wheeled locomotives on account of its being impossible that the axles of such engines should be so far relieved from their load as to endanger the stability of the permanent way. He urges that many of the disadvantages supposed to be attendant upon locomotives of this kind are imaginary, and that others can be avoided by the adoption of proper designs. We cannot ourselves indorse Baron von Weber's recommendation of four-wheeled engines for many reasons which we need not enter into here, and we further consider that by the proper application of compensating levers to six-wheeled engines all the advantages which he claims for the four-wheeled class may be obtained.

We have now concluded our *resume* of Baron von Weber's investigations; and we cannot close our account of these researches without paying a tribute of praise to their author for the energy, patience and skill he has displayed in conducting them. Taken altogether, they form by far the most complete set of investigations of the kind which have ever been undertaken, and we feel certain that Baron von Weber would desire no more satisfactory reward for his labors than to find that he had, by his example, caused other engineers to prosecute similar investigations and extend the field of experimental research he has so ably opened.—*Engineering.*

*It will be noticed on reference to this table, that there are some differences between the loads on the leading and trailing wheels, as given in the third and fifth columns, and those on the same wheels as given in the ninth column. The first-mentioned weights were those obtained by the use of Ebrhardt's weighing apparatus, and those last mentioned by measuring the deflection of the springs, and finding the load due to this deflection. The differences between the two sets of weights are not greater than might have been expected from the respective weights being ascertained with the engines in different positions. It will of course be understood that the weights in columns three and five are those upon a pair of wheels, while those in the ninth column are on a single wheel only.

†This remark applies with especial force to six-wheeled engines having all the wheels arranged under the barrel of the boiler, or other engines in which a large proportion of the weight is carried by the central wheels.

History of Railroad Engineering.

The following sketch of the changes in locomotives and rails during time previous to 1846 was written by an English engineer and published in the London *Railway Register* that year:

The greatest speed of Trevithick's engine was five miles an hour. The ordinary speed of George Stephenson's Killingwood engine, in 1814, was four miles an hour. In 1825 Mr. Nicholas Wood, in his work on railways, takes the standard at six miles an hour, drawing forty tons on a level, and so confident was he that he had gauged the power of the locomotive, that he thinks it right to say "that nothing could do more harm towards the adoption of railways than the adoption of "such nonsense as that we shall see locomotive engines "traveling at the rate of twelve, sixteen, eighteen, and "twenty miles an hour." The promulgator of such nonsense was George Stephenson. In 1829 it was esti-

mated that at fifteen miles an hour the gross load was nine and a-half tons, and the net load very little, and that therefore high speed, if attainable, was practically useless. Before the end of that year George Stephenson got with the Rocket a speed of twenty-nine and a half miles per hour, carrying a net load of nine and a half tons. In 1831 his engines were able to draw ninety tons on a level of twenty miles an hour.

When the speed of the locomotive was set beyond question, prejudice then took alarm about the safety, and a very strong stand has from time to time been made for a limitation of speed. Within the last seven years the London and Birmingham directors considered twenty miles an hour was enough, and had they been free from competition and supported by public opinion, they would no doubt have adhered to that rate, from the conscientious conviction that a higher speed was incompatible with economy and safety. The vigor of the broad-gauge advocates, and the necessity for proving the capabilities of their system, have led them to push on the march of improvement with energy, and the narrow-gauge lines have been forced to follow. Thus the enterprise of directors and the ingenuity of engineers have been kept on the stretch to carry on the rivalry; and we consider the broad gauge as valuable, if on no other ground, that it has tripled the working power of the locomotive, and given us sixty miles an hour, where we should have been lingering at twenty. We recollect the smile of unbelief when it was announced that Brunel had run a locomotive at the rate of a mile a minute, and when at length it was known to be true, it was said that it was not safe, and would never do, and yet it has since then made a working speed.

Thirty miles an hour was thought progress—an express at thirty-five miles an hour seemed to have reached the farthest limits; but in 1846 Brunel succeeded in working the express to Bristol in two hours and a half, and to Exeter in four hours. Mr. M'Connell, the new Locomotive Superintendent of the London & Northwestern, has determined that the narrow gauge shall not be behind, and he has an engine building to carry the express train between London and Birmingham in two hours, and we believe he will do it. Trevithick's greatest net load was ten tons, that of Stephenson's first engine thirty tons. In 1825 the net load was forty tons, in 1831 ninety tons, and now 1,200 tons. These greater effects of the locomotive have been caused by an increase in the size of the parts, and a greater effective power. Trevithick's cylinder was 8 inches in diameter, and he had only one cylinder. Brunton's cylinder was 6 inches in diameter. Stephenson's first locomotive had two cylinders, each of 8 inches diameter. In 1829 the Rocket had two cylinders, each of 8 inches diameter. The Sans Pareil had two cylinders, each of 7 inches in diameter; in 1831 the cylinders were enlarged to 10 inches and 12 inches diameter. In 1832 the Sampson, a powerful engine, had cylinders of 14 inches diameter. Since then cylinders have been increased to 15 inches and 18 inches diameter, as in the Great Western locomotive. The immense increase of power may be inferred from these measurements.

In 1829 the heating surface was about 100 square feet, increased to 200 square feet, and then to 300 square feet; afterwards to 400 square feet, 500 square feet, 800 square feet, 1,000 square feet, and Mr. M'Connell promises to increase it. The fire-box surface in the Rocket was twenty square feet; in the broad-gauge engines it has been increased to above 100 square feet. The weights of the engines have necessarily increased. Brunton's leg locomotive, in 1813, weighed two and a half tons. In 1825 engines weighed five tons, but some, with the tender, weighed ten tons. In 1829 the Rocket weighed four and a half tons, the tender three tons four hundred, the total being under seven and a half tons. The weight of the engine has been increased to eight tons, ten tons, twelve tons, and so up to the Leviathan engine of twenty-nine tons, on the Great Western. The rails have become heavier with the weights of the engines. On the Stockton & Darlington, in 1821, they were laid down at 35 lbs. to the yard. They were successively increased to 50 lbs. and 75 lbs. The London & Birmingham was originally intended for rails of 64 lbs to the yard; but on Mr. Barlow's report they were increased to 75 lbs. Since then rails of 85 lbs. to the yard have been laid down on some lines.

On the other hand, the consumption of fuel has diminished. Before 1829 the consumption of fuel was about 5 lbs. to carry one ton a mile. In that year George Stephenson reduced it to 2.41 lbs. of coke. It would scarcely be credited that it can now be brought to less than a quarter of a pound per ton per mile. The gradients overcome have been steeper. Less than ten years ago a gradient of 1 in 105 was considered as impassable except by means of a stationary engine. A gradient of 1 in 37 can now be managed by a locomotive.

The effect of these enormous changes has been to give the country a very great saving in charges for carrying, to say nothing about the time. The rates for goods have in many cases been reduced one-half, in some cases even to a greater extent; while there is a tendency in the progress of the railway system to a greater reduction. To show in a clearer light the difference between railways and locomotives in 1804, 1829 and 1846 we have drawn up the following comparisons:

1804....	Weight of rails.....	28 lbs.		Weight of engine....	—
1829....	" "	35 lbs.		" "	4½ tons.
1846....	" "	85 lbs.		" "	29 "
1804....	Highest speed	5 miles per hour.		Working speed	2¼ miles.
1829....	" "	29½ "	"	"	10 "
1846....	" "	75 "	"	"	55 "
1804....	Diameter of cylinder	8 in.		Greatest net load..	9 tons
1829....	" "	8 in.		" " ..	40 "
1846....	" "	18 in.		" " ..	1,200 "
1829	...Fire-box surface	20 square feet;		heating ditto....	117 feet.
1846....	" "	108	"	" "	1,000 "

The great object in these remarks has been to show the progressive nature of the railway system, the danger which arises from rash conclusions, and the necessity for caution in prejudging the course of improvement. To sanction novelties may be injurious, but not to prejudge novelties is only prudence. The former savors of quackery; to put down novel inventions on the score of prejudice betokens ignorance, and the latter is more prejudicial. If quackery be allowed to go on its career, it is sure to expose itself; but to check a new invention, because new, can do no good, and may lead to very great public loss.

Locomotive Boilers.

Of all branches of engineering construction there is none so intimately connected with questions of finance as contrivances for the evaporation of water. A large bridge, a costly tunnel, a public building, a system of drainage, each and all of these represent a certain heavy first outlay, and a certain annual cost subsequently for maintenance. Appliances for making steam, however, partake of somewhat different conditions, and whereas the bridge and the building are essentially the exponents of the still life of engineering, the steam generator is evidently something approximating to a living creature, and its utility during its life and the return it makes for its support is as dependent on its original design as is the career of a man proportionate in success to the amount of brain nature has endowed him with. A vast number of novelties, some of them of doubtful value, have been introduced into the designs of various classes of fixed boilers, but for the last twenty years no apprcciable change has been made in the structure of locomotive boilers, and even such innovations as have been introduced are being again withdrawn.

We may reasonably ask whence is this conservation in a particular type of boiler—a type, too, that plays so conspicuous a part in the well-being of mankind, and the performances of which exert so great an influence on profits to shareholders?

It is not merely from the proportion, the consumption of fuel to water evaporated, borne by this class of boiler, but also from the proportion its weight bears to the work it does, that the question is important. It is well known that the wear and tear of permanent way is most largely influenced by the weight of the engine, and so long as enough weight for adhesion can be secured any overplus weight is dead loss to dividends.

The locomotive boiler in its present form is far from perfect; its scale of evaporation to consumption of fuel is low, experiments demonstrating that under average favorable conditions the best results are but seven pounds of water converted into steam by a pound of coal; this is low, too low to be quite satisfactory. The boilers are working under reasonably fair conditions as regards heating surface, yet their performances fall short of slow combustion boilers working under less favorable aspects. Such facts lead us to ask, Whence is the deficiency? and we must, to get an answer, examine the conditions of the high versus the low combustion boilers. Exigences of space necessitate that the quantity of heating surface should be kept within the smallest limits, and to do this the body of the boiler itself must be the receptacle for it; the consequence is that we encroach on water space, and although theoretical laws are unaffected so long as the heating surface is wet without intermission, yet if any portion is stripped for a fraction of time, then that portion for that time is of no value. While cold, every part of the heating surface is wet, but unfortunately this is not the case when the boiler is heated. Most boilers, till within a short time back, were designed without sufficient attention being paid to this, and the results were consequently unsatisfactory. It is no use whatever to arrange a boiler in such a manner that the water is only covering the heating service in films. When such a combustion as that in the fire-box of a locomotive is in action, the films of water are simply converted into foam, and instead of the heated plate being uniformly wet, it is, as it were, spanned by a multitude of hemispheres with their concavities next the plate, and the interior areas of plate are for the time valueless. To place this more clearly to our readers, let us suppose a tube two inches in diameter to have into a tumbler of soda water while the liquid was effervescing. it will exactly illustrate the fire-box, or a tube of the locomotive boiler when the fire is at its fiercest. If we place the same tube in a vessel of common boiling water, we will have a tolerable idea of the condition of the water and heat in a slow combustion Cornish boiler. The lesson to be drawn from these things is that the weight or head of water on the plate should have a direct proportion to the heat of that plate, and when it is less the evaporation will also be deficient in like manner. It is sometimes supposed that the pressure of the steam keeps the water forced down; this is a falacy; the pressure is uniform throughout the interior of the boiler, and the pressure driving the water sideways or upwards is equal to that forcing it to the heating surface. The water can only be kept in constant contact with a particular point, either by having a very great head of water in the boiler—in other words, by covering the heating surface by a depth measured by feet instead of by inches; or it can be done, though not over so large an area, by inducing a system of currents in the direction of the heated plate. Theoretically, the best form of boiler to extract all the heat from a plate would be to make that plate into a tube of moderate diameter; to place it within a larger one; then, while a current of heat went in one direction, through the smaller, the water should move in the opposite one through the annular space. More than this, the heat should move at a determinate and uniform speed, while the water should do the same. The intensity, or, more correctly, the quantity of heat should bear a fixed proportion to the quantity of water. If the speeds and quantities were truly adjusted, if we suppose, for example, a hundred units of heat to be sent through the inner tube, and a definite quantity of water representing precisely the quantity of steam to be made by the heat possessed also, then no heat would waste from the inner tube and nothing but pure dry steam would escape from the other space. If, however, any of the conditions are disturbed, then loss of heat at the one end or waste of water at the other is the certain result. The necessity to keep down the center of gravity of a locomotive prevents any attempt to obtain a good head of water over the tubes, and consequently there is no alternative left us but to devise means to promote currents in the direction of the heated plates. As an evidence of how well practice bears out theory in the question before us, a pump was once fitted to a locomotive boiler in such a manner that it drew water from the smoke-box end and forced it against the side of the fire-box, the result being that the evaporation was inreased about 20 per cent.

This mere increasing of heating surface is valueless unless the water surface is also increased, and suppose that we have a grate consuming 25 lb. of coal per foot per hour, and another burning but half this, it is quite sure that the pressure of water on the former must be greater than that on the latter, though from the deficiency of our investigations on this point no formula can as yet be properly deduced as to the best relative proportions.

We are disposed to think that in the matter of locomotive improvement, as in most other matters, convenience takes precedence of what is calculated to improve, and, although theoretically the locomotive boiler is defective, the work of improving it will be slow; nevertheless it is not difficult, neither would it be expensive, to try some exeriments in methods of promoting forced currents in the water with the view of increasing evaporation.—*Mechanics' Magazine.*

Railroad Legislation.

The passion for regulating the business of the railroads by law has found an expression in the Illinois Legislature, in the adoption of a bill by the Senate which places the road under the severest restrictions. The bill provides that all railroads organized and doing business in the State shall hereafter be limited to such rates on passenger transportation or on passengers' baggage as may be prescribed by law; and makes the companies liable under heavy fines and the forfeiture of franchise for violations of the statute, while the officers are made subject to the penalties of fine and imprisonment.

This measure is introduced for the object of protecting the public against high charges for traveling. Let us see how far the end would be accomplished. It is clear that the first result of the limitation of passenger fares would be a proportionate increase in charges for merchandise and produce, to compensate for the loss to the roads, in which case the public would gain nothing. The next step of the Legislature would, therefore, be to place a like limit upon all freight charges, in which case a thousand evils would come into play. The main features of the business of the roads would be regulated by arbitrary authority, and not by healthy competition. That condition of things would be discouraging, in every way, to railroad enterprise. The existing roads would have less inducement and, earning less, would have less means for providing accommodation for the increasing traffic; and the farmers of Illinois would, therefore, lose much more from the inability of the roads to carry all their produce than they would gain on the reduction of the freights on what the roads might think it proper to provide for. It is an indisputable fact that the more the roads earn the more they extend their lines and increase their carrying capacity, thereby benefitting the sections through which they run, by providing the means for marketing all that may be produced on their route. Let their means for transportation be in any way curtailed and the population which the roads serve is checked in its progress, and the value of its products is reduced.

Again, just in proportion as the business of the existing roads is rendered less profitable is the inducement to build competing roads diminished. Nothing is more certain than that when the inadequacy of railroad facilities enables a road to charge high rates a new road will be provided to profit out of the pressure of business; and the competition for freights thus induced may be safely relied upon to reduce rates to a point favorable to the public, as against the roads. On the contrary, if the profits of the companies are reduced by arbitary regulation, not only do they fail to increase their facilities, but their prosperity is not such as to draw competition into the field. We can conceive of nothing more fatal to the expansion of the West than any policy which would check the expansion of railroad facilities; and we can imagine of no measure better calculated to impose such a check than the one now pending in the Illinois Legislature. The roads are enabled to charge what are deemed high rates only because the railroad accommodation is not up to the wants of the State; and the fact that the growth of trade exceeds the expansion of railway capacity is the strongest possible argument why the inducements to railroad construction should not be lessened. It is no compliment to the intelligence of the Illinois Senate that its members should be unable to see that the very means designed to protect the public would fatally cripple the commerce of the State.

It ought not to be necessary to say to the public of a free country that the only wholesome regulator of commerce is absolute freedom; and yet from the loud outcry for government control of the railroads it would seem that we do not half understand the meaning of liberty, or that, if we comprehend the principle, we do not believe in it. Certain it is that, if we go on as during the last few years in transferring the regulation of business to the Legislature or Congress, there wil soon be no liberty left except that of the governments.—*New York Bulletin.*

Contributions.

MR. FAIRLIE AND NARROW-GAUGE RAILROADS.

No. 9 Victoria Chambers, Westminster, London, S. W., January 26, 1871.

To the Editor of the Railroad Gazette:

I have received two copies of your excellent journal, dated the 24th of December last, containing a print of my letter of the 3d of December and your article thereon, in reply to which I should feel much obliged if you would find space in your next issue for the following few remarks:

First, permit me to bear testimony to the ability displayed in the article in question, and the spirit of fair dealing which marks its tone throughout, leaving on the mind of the readers an impression the reverse of that which was conveyed by the article which called forth my letter.

I do not consider it necessary to reply *seriatim* to the paragraphs as they appear in your article, because these, with one or two exceptions which I now desire to note and extracting the special pleading, will be found quite to accord with the views which I have expressed.

You will, I am sure, admit that to exclude the locomotives from the calculations whilst aiming at the proportions of dead to paying load, is certainly not the way to arrive at the facts. Consequently, if, as you say, the proportion of dead to paying weight of passenger trains on the Pittsburgh, Fort Wayne & Chicago road be 14.8 to 1 without the locomotive, that with it, it will be getting very close to the 29 to 1, which I stated was the average in this country. I would further mention here that as the weight of your rolling stock per passenger seat and per ton of freight is nearly twice as much as it is with us, the proportion of dead to paying load would also be twice as much, were it not that you fill your seats and wagons so much better than we do that you actually bring down the proportions to less than ours; in other words, whilst we carry say 20 passengers for every 100 seats, you carry over 40 persons for every 100 seats, and in thus much your management might be considered better than ours. But there has to be deducted from this advantage the great competition and frequency of trains which our managers have to contend against.

The above favorable proportion—only in comparison with ours, of course—of paying to dead weight, arising as it does from your less memerous but better filled trains, should, if your tariffs are the same for passengers and freight as they are here, produce a gross sum earned per train mile of twice s much as we now earn. It would be a matter of considerable interest to find out, as you might easily do, the correctness of these figures—by a comparison of your tariffs and gross earnings per train mile with ours.

The average sum earned per train mile in the United Kingdom is about 5/8. Freight trains earn on an average from 8 to 10 per cent. more per train mile than the passenger trains.

My paper read before the British Association must be considered with reference to the practice in this country. It does not apply in the same sense to the practice in yours, and whether the truths in it are "profound" or otherwise, they are nevertheless truths, and as such deserve the earnest consideration of all thinking men. My aim is to promote economy and efficiency in the railway system all over the world, so economical in construction that every country and every people may enjoy the great blessings which railway accommodation gives, and after construction, that they shall be so economically worked as not only to insure a return on the capital from a minimum traffic, but that the tariffs to the public shall be largely reduced; moreover, that they shall be found so capable of accommodating an expanding traffic as to operate over them as many passengers and as many tons of freight at a speed of thirty to thirty-five miles an hour, as the *best broad-gauge line in the world can now do.* This, therefore, is the "profound truth" respecting the 3 feet gauge worked by Fairlie engines (be it remembered the Fairlie engine is alike advantageous to all gauges), which I recommend, and which deserves a place not only in the proceedings of the British Association, but in every enlightened journal in the world desiring to promote the well-being and happiness of peoples.

I have extended this portion of my letter beyond what I had intended; kindly excuse it. I now pass to the only points in your article in which I find we differ. (Because, really, it does not affect the question at issue whether your average dead weight is greater or less than ours, but whether we can lessen that which is, because every ton saved in dead weight, either on your side or on ours, is always so much gained to the economy of the line, and, continuing this economy, it would naturally lead to a reduction of tariffs, and thus give increased advantages.) These are the coning of wheels and the dead weight on gauges.

With regard to the first, I beg to assure you that you are mistaken; according to the law of 4-wheeled or 6-wheeled, or any number of wheeled cars with parallel axles and fixed wheels being hauled round curves, the leading wheel flange must rub hard against the side of the outer rail, and the trailing wheel flange must rub against the side of the inner rail. If it did not do so then the law* is that the truck would leave the rails. No truck (which is similarly conditioned to our carriages and wagons) being hauled round a curve will have its center line a tangent to the curve, consequently the position you give of a truck running round a curve, viz., that the leading and trailing wheel flanges should rub hard against the outer rail whilst the opposite wheel flanges will be equally distant from the inner rail—is simply impossible.

Then, with regard to dead weight on gauges, trucks can be made for a gauge of 3 feet which will weigh one ton and carry three tons, say of coal, as an average article. You cannot do this on any gauge beyond 3 feet and have the same strength, whilst you could not do so at all and work on the 4 feet 8½ inch gauge.

I am, sir, your obedient servant,

Rob't F. Fairlie.

*This term is used figuratively.

WOODEN RAILROADS, THE NARROW GAUGE AND THE OLD-FASHIONED "STRAP ROAD."

BY WM. S. HUNTINGTON.

One of the arguments advanced by the advocates of the narrow-gauge system in support of their theory is, that it may be so cheaply constructed as to make it profitable to build short lines for feeders to trunk lines in localities where the traffic would not be such as to warrant the construction of track of the ordinary gauge. This is what may be called "their best hold," as it presents some features that are at least entitled to consideration, which is not the case with most of their "statements."

There is, however, another claimant, in point of economy, for short lines and feeders, which is entitled to more than a passing thought by those who contemplate investing money in a narrow-gauge railroad. I have reference to what is now coming into *fashion* under the name of the "wooden railroad." It is well known that the wooden rail was extensively used in the early days of railroading in this country, and that it is now being resurrected in various parts of the United States and the Canadas, is sufficient evidence that its claims on public notice are not entirely unfounded. No doubt there are engineers who have had the benefit of late experience in the construction and operation of wooden railroads, who could give the public valuable information on the subject. Unless the enterprise has been abandoned, there should now be one of these roads in operation in Northern New York. At least, it was announced, some two or three years since, that the construction of a wooden track had been commenced, and was in a fair way of completion, from Carthage to Harrisville, a distance of 47½ miles. We also have some accounts of a wooden-track road, recently put in operation near Quebec, and others contemplated in various parts of the Dominion. I have seen no published statement of the cost or manner of construction of these, but it seems that the Quebec road is a substantial one, as they are said to be using locomotives of from 19 to 22 tons weight. It would therefore seem that that road was built for "business," and it appears that experiments justify the belief that heavier engines can be profitably used than was at first supposed possible.

Since writing the above, I have unearthed a published report of a committee of Canadian gentlemen appointed to examine and report on the Clifton Wooden Railway. This is the road above-mentioned as located in Northern New York. The committee report as follows:

"The locomotives weigh 10 tons without wood or water, have taken 30 to 40 tons freight a trip, and cost $6,500 each, American currency. They have since been supplemented by engines weighing 20 tons and costing $8,500, which will draw double the weight on the general down-grade from the mines to Ogdensburg, over, in some places, an up-grade of from 80 to 90 feet to the mile as soon as some portions of the road-bed have been strengthened, some of the rails now springing under the immense weight. Mr. Hulburt (the engineer of the road) says the expense of keeping the track in repair will not hereafter exceed the wages of two men for every three miles of road, and these men will keep it in good running order, and replace the worn out rails as fast as required. This does not include renewal of trestle or crib work. We notice that from one to two new rails per mile were put in this spring, and this was rendered necessary from the difficulty of obtaining good sound maple when the road was built; and some of the rails had got "warped" before being used, so that they were laid on the ties "heart-side" up; they will not last so long that way as if the heart of the rail was laid downward. We counted twenty-one track men on the twenty miles we passed over. The track was required to be made ready for the large locomotives as quick as possible. It is estimated that these twenty-ton locomotives will take easily eighty tons per trip, and they intend to make two trips daily. It takes 22,000 feet of maple to lay a mile of track, and from $80 to $100, State's currency, will pay for the labor required to place it in position. We may mention that we came down from the mines at the rate of eight miles an hour, including all stoppages, having about twenty-five tons of freight aboard. Mr. Hulburt is strongly in favor of the gauge generally in use in the United States for railways, and thinks that a narrower gauge than 4 feet 8½ inches will not be found an improvement; though at the same time he acknowledges that rolling stock can be built much cheaper for a gauge, say 3½ or 4 feet, than for the other gauge. We noticed that where in building an iron railway there would have been "steep fills," trestle work was used for cheapness; and in some cases for a long distance where, say a mile or more of low, wet land had to be crossed, the track was made by placing logs crosswise of the road, with stringers upon these logs, the ties being placed in the usual way upon the longitudinal stringers. This gives a cheap road-way perfectly safe for a number of years. When we traveled over the railway the rails were quite wet, and in going up the steepest grades sand had to be used; the cars were loaded with from fifteen to eighteen tons of castings for the works of the mines. The sharpest curves on the road were of 250 feet radius, which would seem hardly practicable; but it is beyond question that such curves are used in several places to avoid rock cuttings. A 14-t n engine can draw, on these wooden roads, on an occasional up-grade of 250 feet to the mile, twenty tons of freight easily, and from 100 to 140 feet grade is not considered very objectionable. Of course the easier the grade the better for any sort of road, and the more level the route can be made, without too great expense, the better. The rails are made of maple, 14 feet long, 6 by 4 inches, laid edgewise. Mr. Hulburt suggests that rails would be best 7 by 3½ inches. The rims of the wheels are like those used on iron railways, only wider, and the flanges a little beveled, so that the flange, in pressing against the rail, does not cut it. We did not see a single rail "broomed up" or cut on the inside, and only a few on the outside, where the heart of the rail had been laid uppermost. The "switches" are made in the usual way, the rails being kept together with iron rods when required to be moved. The "keys" are made of maple plank. The rails are sunk into the ties (which are cut into, 6 inches wide and 4 inches deep) and are kept in place by wedges or keys twelve inches long by four inches wide, and one and a half inches thick at one end by three-fourths of an inch at the other and driven in on the outside of the rail, keeping it against the shoulder of the ties. The ties are put down without being sided. There has not been a single car off the track since the road went into operation. The country through which the Clifton Railway is built is not only broken but even mountainous, and there is no difficulty, in our opinion, in constructing such a railway in almost any part of these townships. From the information obtained as to cost of labor, materials, etc., in the vicinity of the Clifton road, we are of the opinion that the cost of grading, furnishing ties and rails, and laying the same, with a moderate allowance of rolling stock, sufficient for some years, will not exceed for our railroads $5,000 a mile exclusive of large bridges—and this to build in a more permanent manner than the Clifton road is built. We are fully convinced of the practicability of wooden railways, where the principal object is a freight traffic at rates of speed from 8 to 12 miles an hour; and that next to an iron railway, or where the cost of an iron road is too great to be undertaken, that wooden railways can be cheaply built, economically carried on and a large paying business done by their means."

The above report is not very elaborate, but it has the marks of candor about it so far as it goes, and is valuable on that account. The report states that maple is the timber used, and it might be inferred that no other timber was suitable for that purpose. Maple is the most suitable of any timber growing in that region, but oak will answer equally well for the rails or ties. Beech, especially red beech, is excellent for ties, and in fact, any kind of timber that is durable will answer for ties, but it is better that the rails be made of timber that is not liable to warp and is very hard and close-grained.

In regard to the durability of wooden track, the President of the Clifton road says, in a statement on this point (made since the above report), that the company expect to move from 50,000 to 100,000 tons of freight yearly, and that the rails will last 5 or 6 years. He says light trains have been run on that road at 20 miles an hour. It does not appear that any of the new wooden rails are mounted with iron straps after the fashion of the old wooden roads, and it is doubtful whether that was any advantage. The writer had some experience years ago on a "strap road," and it then seemed that the strap was a damage rather than a benefit. Those who are about to build wooden roads will no doubt be interested to know in what way a bar of iron two inches by one-half inch spiked to the top of a wooded rail would be and damage, and I will tell them: Firstly, there is the cost of the iron and spikes, and the expense of laying it, whatever that may be. After this is done, the first injury noticeable is the injury to the rails caused by the spikes. The rails are frequently split and the spikes soon work loose, leaving a space for water to enter, which causes the rails to decay rapidly; and as the iron will not fit the wooden rail so snugly as to exclude water, the wood under the iron is constantly wet or moist, which causes the iron to force its way into the wood, and in a very short time the bar will have settled its thickness into the rail, so that the portion of the tread of the wheel outside of the iron would run on the wood. I have noticed that after a new rail had been in the track a few weeks there would be a layer of pulp one-eighth of an inch thick (or perhaps one-sixteenth would be nearer the truth) between the strap and the rail, while that portion of the wood outside the strap remained sound. Of course this pulp was formed from the fibers of the wood which had become separated by the action of the moisture assisted by the vibration of the strap while trains were passing, and was nothing more nor less than decay. I also noticed that the portions of the rails outside the straps that were acted upon by the tread of the wheels grew hard instead of "pulping" like the portion under the iron. The rolling of the wheels on the wood had the effect to expel the moisture (on the principle of a clothes-wringer) and to compress the fibers of the wood and in a great measure prevent decay. It is doubtful about the straps strengthening the rail to such an extent as was generally supposed. A bar of iron one-half inch or five-eighths inch thick laid flat-wise would of itself sustain only a light load, but by reason of its continuous support by the wooden rail would add considerably to the strength of the wood. But it is safe to say that the strap will not strengthen the rail sufficiently to warrant the expense of using it. Another serious objection to the strap is contraction and expansion, which frequently renders it difficult to keep the track in a safe condition. I have seen these strap rails buckled and twisted by the force of expansion until they were torn from the track, in fact resembling a quantity of old harness strewn along the track. Another trouble arising from the use of iron on a wooden rail is what we used to call "snake-heads." The action of heavy loads rolling over these flat bars is similar to that of the machines used for bending wagon tires, giving the ends of the bars a tendency to rise, drawing the spike with it. It is exceedingly difficult, I may say impossible, to prevent this, and when the bar has once commenced bending it seems to bend more rapidly, or the more it is bent the easier it bends, and pretty soon the bar is curled up in the form of a section of wagon tire. These are the "snake-heads," and so long as they did not reach above the center of the wheels they were not regarded as dangerous; but as soon as a wheel struck one that had curved a little too much, there was mischief. Those who have never witnessed a wheel running under a snake-head can scarcely imagine its effect. A 20-foot bar of iron wriggling its way through a well-filled passenger coach has, on more than one occasion, resulted in the mangling of as many human forms as some of our first-class "smash-ups." To all these charges against the strap rail may be added the expense of track repairs, which will obviously be much greater with than without the iron. From the nature of the combination of the wood and strap rail, it is necessary that it be kept in good repair. Of course this is important on any railroad, but a slight derangement of the strap road would be dangerous, and such a road would need constant watching and would require a larger number of men to keep it safe than a well-built wooden track without the straps.

And, finally, if cheapness is the main reason for building a wooden railroad instead of an iron one, the least iron used, within reason, the better. There are thousands of places in this country where wooden tracks could be built and operated with profit; and in most of such cases where the traffic would not pay for the building of iron roads at present, if wooden roads were now built the traffic would increase so that by the time the rails need renewal, or extensive repairs became necessary, it would pay to lay a substantial iron track. It would therefore seem advisable to use the present standard gauge (4 ft. 8½ in.) The road-bed would then become firmly settled and everything in good condition for the iron, to say nothing of the convenience and economy, in the meantime, of moving freight without transhipment. The rolling stock on a wooden railroad may be so constructed as to run with safety on iron roads connecting, so that cars may be run into the timber regions or the mines, and loaded and sent to market without unloading; and if cars were so built they need not be thrown away when the change is made to an iron road, and that would be money saved.

Gradients and Distances as Affecting the Cost of Transportation.

General Hermann Haupt, the distinguished engineer, in the course of an extended report on the route of the proposed Shenandoah Valley Railroad discusses the above questions with much ability. An abstract of this portion of his report we copy from the *United States Railroad and Mining Register:*

COMPUTATION OF THE EFFECT OF GRADIENTS.

It has been the practice of engineers to consider 16 or 18 feet to the mile as the angle of friction on which cars would run by gravity. This angle has an important influence in the determination of the powers of an engine and the influence of gradients; and no better reason appears to have existed for the adoption of 16 or 18 feet to the mile than the statements of early writers on engineering, which have been accepted as correct.

The experiments for the determination of this angle were made with cars in extra condition, on roads in perfect order, and at slow velocities, and the results do not represent the actual resistance in the ordinary condition of track and machinery, and at the usual velocities in actual operation.

To obtain reliable data, General Haupt prepared a formula from which, by the substitution of the maximum loads of a standard engine on any two different grades, all the data necessary in the solution of the ordinary problems of gradients could be determined, based on actual results of operation.

The data was obtained from A. J. Cassatt, Esq., General Superintendent, and Herman J. Lombaert, Vice-President of the Pennsylvania Railroad, who furnished the information, viz:

A standard 10-wheel freight engine, used on the Pennsylvania Railroad, with three pairs of 4½ feet drivers, average water and coal, weighs	75,000 lbs.
Weight on drivers	53,000 lbs.
Weight of tender, with coal and water	50,000 lbs.
Will haul, at ten miles per hour, on ten feet grade, as a safe load, in all ordinary conditions of rail	40 cars.
And on a grade of 52 2-10 feet	16 cars.
The car and load being 20 tons	40,000 lbs.

By the substitution of these results in the formula, it was found:

That the whole tractile power exerted by the engine was	11,160 lbs.
The tractile power per ton of load on a level	9 2-10 lbs.
The gross load on a level, in tons of 2,000 lbs	1,2 0 tons.
The adhesion, in terms of weight on drivers	one-fifth.
The angle of friction in feet per mile	24.28

And the following simple formula is given to determine the load of such standard engine on any gradient whatever:

$$W = 11{,}160 \div 9.2 + 38a.$$

in which W represents the gross load in tons of 20,000 pounds, and a the grade per mile in feet.

DISCUSSION OF THE QUESTION OF GRADIENTS.

This paper discusses the general question of gradients, their distribution and their effect on the economical operation of a line. The writer takes the position that many erroneous ideas are prevalent on this subject, and, in consequence thereof, capital has been wasted to secure results of no value practically when attained, while matters of much greater consequence have been neglected.

Some of the positions taken by the writer are that the load of an engine is determined by the maximum resistance encountered from grade and curvature on the division over which it runs, and that while a large expenditure is admissible to reduce the maximum resistance, yet, where these are fixed, it is unwise to make large expenditures to reduce grades at points of less resistance, as not a single car can thereby be added to the train, and no economy of operation sufficient to justify the expenditure can result therefrom.

It is also argued, that when the maximum resistances are determined, undulating gradients below the limits of such resistances are not seriously objectionable, and may properly be used to reduce cost of construction without adding appreciably to cost of operation; thus, the sacrifice of capital sometimes made by engineers to secure long uniform gradients are improper.

It is also claimed, that in cases where it is necessary to use assistant engines, it is far better to use a gradient sufficient to absorb the whole power of the assistant engine, rather than a lower gradient, even if the length of road, in both cases, should be equal.

For example, if the ruling gradient should be 30 feet to the mile, a grade of 80 feet would require double power, and great economy, both in construction and operation, would result from extending the 30 feet grade 20 miles, and using the 80 feet grade with assistant power 10 miles, rather than a uniform grade of 47 feet for 30 miles. This position is obviously correct; for, as the full power of the single engine was supposed to be exerted on the 30 feet grade, any increase would require a division of trains or assistant power, and it would be more economical to use the assistant engine 10 miles than on 30 miles.

It is also maintained, that questions of relative economy in the operation of different lines, cannot be determined by computations of rise and fall, but that it is necessary to consider the direction and amount of the tonnage, the maximum resistances and their distribution; thus the old modes of computation are fallacious, and questions in railway economies must be decided by the data which each case presents, and not by application of general principles.

After a full discussion of the subject of gradients, an application is made of the principles established to the case of the Shenandoah Valley extension. The fact is stated that a ruling gradient of 3[illegible] feet to the mile can be established from the intersection near Knoxville to the Potomac, using assistant engines possibly at two, but probably only at one summit. That the use of such engines will add only 23 mills per ton for the whole distance to the cost of transportation, which would be less than the cost of operating three additional miles of road if the summit could be overcome by such extension of distance; and that no other great line, connecting the West with the eastern mountain chains, admits of such a favorable system of grading of such extraordinary economy in operation. The writer states that the nearest approach to such a system of gradients is on the Pennsylvania Railroad, the credit of which was due to J. Edgar Thomson, when Chief Engineer.

CONSIDERATIONS AFFECTING THE VALUE OF DISTANCES IN CONSTRUCTION.

This paper gives a tabular statement from the operations of the Pennsylvania Railroad, showing the items of freight expenses which are increased by an increased tonnage. Also, a second statement of items of expenses incurred by extending the length of the road.

The results are:

Total freight expenses on Pennsylvania Railroad, for 1869	$9,035,031 00
Freight expenses incurred by tonnage	4,979,495 00
Freight expenses incurred in proportion to distance	6,381,658 00
Whole cost of running freight trains per mile	1 30
Cost of running freight trains per mile of increased distance	1 00
Percentage of variable items increased by tonnage	55
Mileage of freight trains	6,904 888
Tons moved one mile	753,711,312
Whole cost of running freight per ton per mile	12 mills,
Cost of an increased tongage per ton per mile	6½ mills.
Cost of renewals of rails per ton per mile	¾ of one mill.

The number of trains passing a given point on the Pennsylvania Railroad is 26,000 per annum. A mile of distance saved would save $26,000 on these trains, or the interest of $433,000, which represents the value of a mile of distance on the present enormous tonnage of over five millions of tons. When the Pennsylvania Railroad was located, distance was estimated at only $53,000 per mile. If estimated then at its value, road and cost of construction included accordingly, the Pennsylvania Railroad could never have been built.

The proper medium between a necessarily expensive location, adapted to the ultimate development of the business, which would render construction impossible, and a cheap line which, for future operation, would be useless, is found in a line located with reference to the future, but reduced in cost of construction at heavy points by temporary lines, which can be used until the accumulations of a contingent fund or other resources will render the final construction possible.

The observation is made, that while the average freight tonnage on the Pennsylvania Railroad, in 1869, cost 12 mills per ton per mile, and an increased tonnage could be carried at 55 per cent., or 6 6-10 mills, yet, on roads doing a small business of 200,000 tons or less, the cost per ton runs up to two or three cents, and the percentage of cost of an increased business falls to 30 or 40 per cent., the cost of the increased business being more nearly constant on all roads, or from six to eight mills per ton per mile.

Responsibility for Injury to a Passenger Getting off a Car.

In a recent case in which the Illinois Central Railroad Company was defendant, damages were asked for an injury causing death to a passenger who was thrown under the wheels by the sudden starting of a train as he was getting off at Tamaroa, Ill. In the Circuit Court a verdict was given against the company for $1,166. In the Supreme Court of Illinois this decision was reversed, Judge Breese expressing the opinion of the court as follows:

"We think this testimony overthrows the theory on which this case is based, and so overwhelmingly in favor of the defense as to demand from the jury a favorable verdict. The evidence recited satisfies us that deceased had got on to the station platform, and still clung to the railing of the car steps, and by so doing was dragged to his death. This was no fault of the company; no negligence can be imputed to them unless it be shown that by bad management of the train, or careless conduct of their employes, deceased was placed in a perilous situation. The proof is abundant that the train stopped an unusual time—for a time sufficient to enable the passengers to leave it safely. If the deceased did not avail of this opportunity, but chose to attempt to get off when the train was again in motion, and this without the direction or knowledge of any employes on the train, it was his folly, and the consequences of it must rest upon him alone.

"The testimony so greatly preponderating in favor of appellants, the verdict should have been in their favor. The court should have set it aside on motion for a new trial. It was error to refuse the motion."

—The Missouri Senate has passed a bill making personal property as well as real estate liable for county and town subscriptions to railroads.

Railroad Systems.

Mr. F. R. Delano, Superintendent of the St. Paul & Pacific Railroad, contributes an article to the St. Paul *Press* on narrow-gauge railroads, in the course of which he speaks as follows of the adaptation of the capacity of railroads to their business.

A varied experience since 1839 with the American railroad system, all the way from Massachusetts to Minnesota, leads me to the following conclusions :

That from the rapid construction and consolidation of trunk lines, and the varied requirements of patrons thereof, that it is necessary that the great trunk lines across our continent from east to west should be composed of 4 tracks, of the 4 feet, 8½ inch gauge—two tracks for passengers, and two for freight, with sidings at every ten miles, to admit of the passing and meeting of trains.

The whole business of these lines should be governed by the speed of the trains, both passengers and freight.

Passenger trains denominated first class should have a time card of 50 to 60 miles per hour, and as much more as possible on which all persons willing to take the risk incident to that speed could travel, and the price per mile would be in proportion to the expense of maintaining such trains.

Second class passenger trains which would run at a regular speed of 25 miles per hour.

Third class passenger trains at 15 miles per hour.

For passage on either class of these trains we would pay our money and take our choice.

On the freight tracks there would be run four classes of trains :

First class, 25 miles per hour.
Second class, 15 miles per hour.
Third class, 10 miles per hour.
Fourth class, 6 miles per hour,

and the price of freight in proportion to speed. If you are in a hurry, pay for it. From these great trunk lines, side lines of the same gauge, but with generally a single track, will be built and operated in close connection and sympathy therewith. From these side lines, and also from the great trunk lines, the narrow gauge 3 feet, 30 inches and 2 feet will come in to the relief of all, and will be emphatically the country roads —the farmers' road.

The narrow gauge will have its cheap road-bed, culverts and bridging ; will have its light track ; will have its small engines and cars ; all will be of as good workmanship, and will be as comfortable and convenient for both passengers and freight as the present style of cars, and they can all be accommodated by having railroads, and they will pay, both for the transportation of themselves and freight, such sum as the speed at which they wish to move demands.

The cost of the 4-track line would be from $100,0 0 to $150,000 per mile.

Cost of the single or double 4 feet 8½ inch gauge side lines the same as now, from $30,000 to $80,000 per mile according to locality.

Cost of the narrow gauge of 2 feet, 2½ feet and 3 feet from $6,000 to $10,000 per mile as per locality, and when the narrow gauge line should become too heavily taxed with business, or extended in length beyond what was ever intended or thought of in its first inception, it can very easily be converted into a 4 feet 8½ inch gauge by widening its embankments and excavations, extending culverts, making stronger bridges, putting down new ties and iron, and putting on the equipment of the 4 feet 8½ inch gauge, and using your narrow gauge, track and equipment where its location is required.

Boiler Priming.

A correspondent of the *English Mechanic* gives the following account of his experiments concerning boiler priming :

Having seen the letter of "M. E." in your impression of the 25th November, respecting priming in steam boilers, I write this letter, as I have conducted a series of experiments concerning its nature and causes, and have arrived at definitely marked results : having satisfied myself as to its causes I can propose a remedy. The cause which principally conduces to the production of priming, is the unbalancing of the steam pressure, so as to bring it below that which is consistent with the temperature of the body of water in the boiler, or, which is the same thing, taking more steam from the boiler than it is at that moment generating.

My experiments were conducted about eighteen months since ; the following is a description of them : I took a glass tube 2½ in. diameter, 2 ft. 6 in. long, capped with brass at each end ; connected the covers by a bolt passing through the tube, and formed the joints of two rings of galvanized india-rubber (vulcanite) ; on the upper cover was placed a safety-valve, having a seating which was nearly an edge, very narrow, and I took care so to adjust it, as to have the centre of the fulcrum-pin, the point of application of the lever to the valve, and the point of application of the weight to the lever, in the same horizontal line, at the moment of the valve's opening ; I mention this since I have seen many valves which favored priming so soon as they rose from their seats. Having filled this miniature generator two-thirds full of distilled water, I placed it over an adjusted gas burner, and loaded the valve to five atmospheres (in subsequent experiments other pressures were used) ; steam bubbles, or beads formed at the bottom and traversing the column produced a steady rolling water level, which did not vary at the escape of steam from the valve. I now slightly eased the valve by shifting the weight ; a number of small beads formed in all parts of the water column, none of them so large as those formed upon the fire-plate, but collectively they were of much greater volume, proved by a higher water level, and that agitated greatly ; the water soon gave up its heat, however, and resumed its old level ; I then shifted the weight a trifle further, but only sufficient to relieve the pressure to the extent of 3 lbs. per square inch. the whole mass of water effervesced with violence, as the bulk appeared to be constituted of small beads, which, breaking up the large boiling beads, appeared to amalgamate with them, and although the valve was but one-quarter of an inch in diameter, yet one-third of the water had passed it before it had rendered up its superabundant heat and small amount of surplus steam ; this was a real case of priming.

Repeating these experiments, I next substituted for the distilled water, water slightly mixed with river mud in such proportions as to obtain a mixture of about the same consistency as that usually employed for steam boilers. I found the results to differ from the former in this only, that the priming was more readily induced and a greater quantity of water passed over than in the former case. A saline solution was next used. Results differed from former only that when I injected a small quantity of distilled or river-water, a higher level was attained—much higher than that due to the injection alone—and a number of small beads appeared, precisely similar to those which were formed when the valve was slightly interfered with. I am of opinion with Mr. Bourne that this was occasioned by the excess of temperature due to the saline solution. If this was so, the salt water soon gave up its extra heat to the injection, and resumed a natural level. As there is a tendency to prime with fresh injection water, would it not be better to deliver the feed close to, or even above the surface, when the vessel is about to enter river water from the sea ? At one time I concentrated potash liquors in boilers, which I used for the purpose of driving my engines, and, after the contents had become concentrated, I was obliged to inject at the surface. Although I used large cylindrical boilers, yet I found, as an invariable result, that injection below the surface was attended with priming.

The experiments with the glass tube were then repeated, the contents consisting of water, densely thickened with river mud taken from the Thames, and also with saline solutions of various strength ; but although slight differences were observed to be due to the variance of solution, yet they did not present any marked characteristics sufficient to render them worthy of record, but I noticed as a general consequence that priming did not take place until the equilibrium existing between valve and steam pressures had been destroyed. I here noticed a fact fully sufficient to account for the small steam-space required in high-pressure boilers of great evaporative power—viz., that the size of the boiling beads followed the law of expansion ; that is, that beads generated at a pressure of one atmosphere were of twice the size cubic, apparently, of those generated at a pressure of two, and so on. When I say that the beads formed under two atmospheres were half the size of those formed under one, I wish it to be understood that they were less, indeed, in size, but were greater in numbers ; that is, there were more of them, but the aggregate of those formed under two atmospheres were of but one-half the bulk of all those formed under the lesser pressure of one, as proved by the boiling level, which as the pressure was increased gradually approached the original level of the quiescent water ; and by increasing the pressure I succeeded in obtaining a very neat boiling line. At this stage of my progress the strength of my glass tube proved inadequate to support the pressure to which it was subjected, and an explosion was the result when the pressure was, I should imagine, about six or seven atmospheres. I, and others to whom I have spoken about priming, have worked troublesome boilers by keeping a high back-pressure over that required for the engine, or, as they say, I am sure I don't know why, by wire-drawing the steam. This is of course a foolish way of meeting priming, and may lead to serious results in the hands of inexperienced persons ; for, since the liability to prime decreases as the back-pressure is increased, this is of itself a temptation to the engine-driver to overload the valve under his care. But this is not the only evil attendant upon this practice, for by its means the consumption of fuel is increased, as the products of combustion escape in a highly-heated condition without having performed an adequate amount of work.

The following simple experiment will illustrate my previous remarks :—Take an ordinary Florence oil-flask, and, after having filled it about three-fourths full of water, set it upon the fire, previously inserting a cork : this need not be pushed in tightly—as nearly as the experimenter can judge, two pounds per square inch, or even less. When the water is sufficiently heated the cork will be driven out, and it will be observed that a great quantity of water will pass over with the liberated steam. This quantity will be proportioned to the excess of the steam-pressure within the flask, above the atmospheric pressure without it, the excess being measured at the moment of the cork's liberation. This will continue until the temperature of the water is reduced to 212° Fahr., 100° Cent., or thereabouts, according to the height of the barometer at the time of the experiment. As your correspondent remarks, priming leads to innumerable accidents, in many cases bringing the water-level of the boiler so low as to leave uncovered parts exposed to the influence of fire ; in others sudden destruction of the machinery results. About thirty years ago I witnessed the break-up of a nearly new beam engine, which had been left at dinner-time slowly at work taking in its feed water with its throttle nearly closed and disconnected from the governor. By some slight jar the lever fell over, giving the engine a full steam-run from the boiler ; water followed almost immediately, and the beam broke in halves at the main gudgeons, and scarcely any portion remained in a perfect condition. But even when water enters the cylinders in small quantities very evil consequences result, as I will attempt to show. I have had pistons at work for many years, and at others for not so many months, and a long time elapsed before I was enabled to discover the cause of the short life of the latter ; but I can now immediately detect it from the appearance presented by such pistons when opened : water has been frequently coming over, but not in quantities sufficiently large to command notice. When water is present in the cylinder it prevents the formation of that hard surface which is so well known to engineers, and which will in most cases resist the action of the file for a great length of time. I have also noticed in engines upon Wolfe's principle, which have been carelessly constructed, and in which the high-pressure piston did not rise high enough in the cylinder to empty the water over the ports, that the cylinder and piston were rapidly worn away, as the water was constantly in contact with those parts ; while the low-pressure cylinder has worked admirably for years. I have shortened the rod of the high-pressure piston so as to allow it to expel the water, and it worked well ever afterwards ; but all circumstances remaining the same, the high and low-pressure cylinders can never compare together, since the low exhausts into a vacuum (comparative) and the evaporation keeps its surface nearly dry.

Returning to priming, I may here state that I remember having seen, when a boy, an engine worked wholly upon this principle, which belonged to Mr. Perkins, known for his invention of the steam gun. The generator consisted of a series of long hollow blocks of cast iron, having a square section. They were connected together, and the water was forced through, or into them, at a pressure of about half a ton per square inch. On account of the high temperature to which that portion in the generator was subjected, at each stroke of the engine, which was of the single-acting description, a measured jet of this water was introduced into the cylinder, at the commencement of each stroke, through spring valves, which, at so high a temperature, flashed immediately into steam, which was dry, for I saw no signs of water from the exhaust. I cannot say what quantity of water was ejected, as I was young at that time. I mention this, in order to show how soon an enormous amount of imprisoned heat is liberated, so soon as pressure and temperature are interfered with.

It is evident, from the experiments described in the beginning of this letter, that if an apparatus could be framed for the automatic regulation of steam boilers, so as to prevent the passage of more steam than was at any moment being generated, which would act without back-pressure and give the exact area of passage for different pressures and temperatures, a means of preventing steam-boiler priming would be afforded. Such a valve I myself made about fourteen months since, and I applied it to a small boiler which I had erected on purpose for its trial. This boiler was set in a manner most conducive to priming, since nearly the whole surface was exposed to the fire ; I made a regulator to this, and could not, on any occasion, obtain priming through the regulator. Quite satisfied with it, I patented it. I have since made a regulator for a 2½ in. steam main, acting as stop-valve also ; the apparatus does not occupy more room than does an ordinary stop-valve ; I still possess the 2½ in. valve or regulator, and if your readers wish for a further description, will send drawings and index.

Another correspondent of the same journal gives the following description of the process by which priming was prevented in one case :

In 1845 or 1846, I cannot exactly say which, I was at work upon a locomotive in which they dispensed with the dome and inserted a steam pipe ; the steam was conveyed into a box in the chimney end, inside of which was a gridiron regulator. When the engine was tried it primed so much that, as well as its being a nuisance, it was not safe to work. There was no keeping water in the boiler. After many schemes, to no purpose, two pieces of angle iron, 2 in., were bolted along the barrel of the boiler, which made a perfect cure of it, and no better engine ran upon the line.

Validity of Conductors' Checks.

An interesting case, concerning the rights of passengers holding conductors' checks on railroads, was recently tried in the Superior Court of Baltimore. The plaintiff on May 1, 1867, purchased a through ticket from New York to Baltimore, and proceeded on the Philadelphia, Wilmington & Baltimore Railroad as far as Perryville, where he left the train, the conductor, after leaving Philadelphia, having taken up the through ticket, and having given the plaintiff a check in place of it. On the 6th of May the plaintiff got upon the train for Baltimore at Havre de Grace, and offered the check in payment of his fare, which the conductor refused to receive, notwithstanding the plaintiff's assertion that on leaving the train at Perryville, on May 1, he was informed by the ticket agent in the office at that place that the check would be good on any other day. On the plaintiff's refusal to pay the fare in money he was ejected by the conductor. In the action brought to recover damages for this ejection, the Court instructed the jury that the plaintiff was not entitled to recover unless more force was used than was necessary to put him off the train, and unless he was put off at a point where there was no station house at hand, or no place for shelter and food. The Court also held that if the check had been indorsed in writing by the ticket agent or by the conductor of the train of May 1, that it was good for another train at a subsequent time it would have bound the railroad company ; and that the conductor of the train of May 6 was not required to take the passenger's word, unsupported by a written authorization.—*Exchange.*

—In the Ohio Legislature a bill has been introduced to limit the charges for seats or berths in sleeping and dining cars.

General Railroad News.

OLD AND NEW ROADS.

Middlesex Central.

This projected railroad, which is to extend from Lexington, near Boston, Mass., to Brookline, N. H., a distance of 33 miles, a correspondent informs us, is progressing as fast as can be conveniently pressed. A charter is about to be applied for it in the Legislature. This is one of the largest railroad projects in importance to be presented at this session, and when the railroad is completed it will open a large and now out of-the-way country.

Leavenworth, Lawrence & Galveston.

There has been for some time a bitter feeling toward this company on the part of Leavenworth, because while it has provided an outlet to Kansas City and runs trains to and from that place, it has made no preparations to extend its line north of Lawrence. But the company announces that it will construct a bridge over the Kansas River at Lawrence within the present year, and thereafter run trains through from Leavenworth by way of the Leavenworth & Lawrence Branch of the Kansas Pacific over its road, as well as from Kansas City.

Dutchess & Columbia.

A correspondent writes to us that this road has just been completed to its eastern terminus, on the State line of Connecticut, near Millerton station, on the Harlem Railroad, 93 miles above New York city. It is 58 miles in length, commencing at Fishkill-on-the-Hudson, 58 miles above New York city, and extending in a northeasterly direction across Dutchess County to the terminus above mentioned. It has been in successful operation from the Hudson River to Pine Plains, a distance of 43 miles, for a year past, and the whole road will be opened for public traffic on the 1st day of March. At its eastern terminus this road will join the Connecticut Western Railroad, now nearly completed to Hartford, at which point it will connect with the Hartford, Providence & Fishkill Railroad, leading to Providence and Boston, forming a most favorable route from all New England to a point on the Hudson River opposite Newburgh, the terminus of the Erie Railway, and the coal-shipping port of the Pennsylvania Coal Company. The capital stock of the Dutchess & Columbia Railroad is $1,500,000, and first-mortgage bonds to the same amount have been issued. The President of the road is Mr. Geo. H. Brown, formerly of the firm of Brown, Brothers & Company; Chief Engineer, Mr. Oliver W. Barnes, formerly of the Pennsylvania Railroad. The directors reside along the line of road in Dutchess County. The Superintendent is Mr. Benjamin Strong, of Fishkill, N. Y.

Erie Railway.

A telegram from New York announces that the Erie Railway Company has executed a new consolidated mortgage on all its property for $30,000,000, of which $24,000,000 will be expended in taking up the existing mortgages at maturity, and the remainder, it is rumored, will be used in laying a third rail between New York and Buffalo and purchasing an equipment for the connections with narrow-gauge railroads thence to Chicago.

North Missouri.

Ottumwa, Iowa, has voted a tax of 1½ per cent. to aid in an extension of the North Missouri northeasterly to Sigourney and Cedar Rapids.

Louisiana & Missouri River.

It is proposed to make a St. Louis outlet to this road by constructing a branch from some point in Howard County not far from the' crossing of the Missouri, and thence east by south through Columbia, the county seat of Boone, and Fulton, the county seat of Callaway, crossing the Missouri near Howell's Ferry. Thus a new route from St. Louis to Kansas City, shorter than any other, would be formed.

Toledo Ann Arbor & Northern.

President Garrett, of the Baltimore & Ohio Company, has promised to take $100,000 of this company and to furnish a market for its bonds, provided the company will obtain means sufficient, in addition to his stock subscription, to pay for half the expense of the line, the other half being provided by the sale of bonds. This will require subscriptions of about $150,000 by Monroe and Washtenaw counties, Michigan. The road, if built, is to be leased to the Baltimore & Ohio Company.

California Railroads.

The San Francisco *Bulletin* gives, as follows, the number of miles of railroad constructed by the different companies in California in 1870: California & Oregon, 40; San Joaquin Valley, 20; California Pacific, 42; Southern Pacific, 30; Los Angeles, Wilmington & San Pedro, 18; Petaluma & Santa Rosa, 15; San Rafael & San Quentin, 3½; Copperopolis, 31; total, 171½ miles.

Sheboygan & Fond du Lac.

The lower house of the Wisconsin Legislature has passed a law authorizing the extension of this road to the Mississippi and an increase of the company's stock.

Iowa & Chicago.

A notice is published in the Dubuque papers announcing the formation of a corporation by this name for the purpose of constructing a railroad from Bellevue, a town on the Mississippi about 28 miles southeast of Dubuque, in a general westerly direction to Cascade, near the southwest corner of Dubuque County, and thence northwestward on a route which a correspondent describes as follows:

"Striking the Dubuque Southwestern road at or near Sand Springs, in Delaware County, thence probably to Manchester, where it will intersect the Dubuque & Sioux City road, thence continuing the same general direction towards Northwestern Iowa."

Our correspondent, an officer of the road, says:

"The project has been well worked up already, and local aid promised amounting to about $3,000 per mile. A reconnoissance of the line has been made, and a favorable route ascertained. A preliminary survey will be made as soon as the weather becomes favorable for field work.

"This line will afford a large portion of the people of Iowa a more direct outlet to Chicago than does any other existing or projected road; hence towns and individuals are making voluntary proffers of aid to help it along.

"You will perceive by the notice of organization that it is contemplated to bridge the Mississippi River. This will probably be at Bellevue, where the facilities for bridging are unequaled."

The proposed line would naturally form a tributary to the Chicago & Iowa Railroad, which already has a contract for a lease of the line under consideration from Dubuque down the river through Bellevue; but it could very easily be connected with the Chicago & Northwestern. It is nearly parallel with the Burlington, Cedar Rapids & Minnesota Railroad, and about thirty-five miles from it, and from Cascade northwestward its route is nowhere more than a few miles from that adopted for the Davenport & St. Paul Railroad, which, through the misfortunes of the Ames, is likely to be delayed for some time.

Rockford, Rock Island & St. Louis.

The injunction restraining the issue of the $200,000 of bonds subscribed by Warren County, Ill., having been discussed, the Board of Supervisors of that county have directed that the bonds be issued. The Monmouth *Atlas* says that the company promises to establish its repair and construction shops at Monmouth if no further opposition is made to the issue of the bonds.

Brunswick & Albany.

Overton & Lewis, who have the contract for the construction of this important Georgia railroad from Albany eastward to the Alappaha River, about 60 miles, intend to put on a force of 2,000 men, if they can be obtained.

Kansas Pacific.

Extensive preparations are being made to provide accommodations for the cattle trade this year, which, we learn, promises to be larger than ever before. There will be three great shipping stations on the line—Abilene, 162 miles from Kansas City; Brookville, 200 miles, and Ellsworth, 223 miles from that place. Good hotels for drovers and buyers and convenient yards for cattle will be maintained at all these places, and there will be no charge to shippers for the use of the yards. At State Line (close to Kansas City) cattle yards on a large scale, with something like the completeness of the Union Stock Yards in Chicago, will be established, and efforts will be made to make this place the great cattle market of the Southwest, for which it is well fitted in many respects, as the Fort Scott road, and the Lawrence road also will bring their cattle to Kansas City.

Camden & Amboy.

This company proposes to issue in England £500,000 sterling 6 per cent. mortgage bonds, principal and interest payable in sterling in London, free from all Federal or State taxation. The bonds are of £200 each, and the price of issue 92 per cent., or £184 per bond. The repayment of the bonds is secured by an annual sinking fund of 2 per cent. There could not well be a safer investment, and English capitalists do not very often have an opportunity to get 6½ per cent. on their money with first-class security.

The Cincinnati & Newport Bridge.

An effort was made this week in the House of Representatives at Washington, to bring up the resolutions requiring the bridge to be made 100 feet above low water. The vote was 113 yeas to 76 nays, indicating that the resolutions will pass if reached. The Pennsylvania Railroad Company, which is building the bridge, opposes these requirements stoutly.

St. Louis to Galveston.

A correspondent of the St. Louis *Republican* advocates building a road from Pierce City, or Neosho, in the southwestern part of Missouri, south along the west border of Arkansas, through Fort Smith, Arkansas, and Jefferson, Texas, to Galveston.

St. Louis & Santa Fe.

About twenty miles of track was laid, up to the commencement of this week, from Holden, a station on the Pacific of Missouri, west to Harrisonville.

St. Joseph & Iowa.

This company contemplate building about 80 miles of road from St. Joseph northeastward to Princeton, Mo., connecting there with the Chicago & Southwestern Railroad, and making a very direct route between St, Joseph and Chicago. The city of St. Joseph has subscribed $500,000 to its capital stock, payable in stock of the Kansas City, St. Joseph & Council Bluffs Company, and arrangements are making for commencing work on the road at once.

Providence & Worcester.

At the recent annual meeting the directors were authorized to lease the proposed Massachusetts road from Milford to Ashland and also the Milford & Worcester Railroad upon terms satisfactory to the directors.

Delaware, Lackawanna & Western.

We learn from the New York *Bulletin* that this company have made arrangements for ferrying freight cars across the river from Hoboken to New York, and that hereafter all freight from the Syracuse, Binghampton & New York Railroad, Oswego and Syracuse division, and Utica division from Norwich and points south of there, will be delivered in New York direct, without transfer.

Mississippi & Missouri Air Line.

According to the Quincy *Whig*, this road, which was lately completed from West Quincy north to La Grange, has been consolidated with the Mississippi Valley & Western Railway—this last-mentioned name being the title of the consolidated company. The roads will connect at or near Alexandria, Mo., nearly opposite Warsaw, Ill., and probably continue northwest, and west through the southern tier counties of Iowa.

East Brandywine & Waynesburg.

Work is going on rapidly on an extension of this railroad from Waynesburg westward about ten miles to New Holland, in Lancaster County. It is proposed to extend it still farther westward, about 20 miles, to Manheim, on the Reading & Columbia road, or to some point on the Pennsylvania Railroad a little further south. If this extension is made, the line will be about 50 miles long, extending from Downington, on the Pennsylvania Railroad 34 miles from Philadelphia, westward nearly parallel with the Pennsylvania Railroad and a few miles north of it.

Cincinnati, Rockport & Nashville.

The building of this road has been urged and aided by Cincinnati interests in order to form a new competing line between that city and Nashville. It is intended to start either at Mitchell, Indiana—where the Louisville, New Albany & Chicago and Ohio & Mississippi railroads intersect—or at Loogootee, 31 miles farther west. Crossing the Ohio River at Rockport, it will continue south through Owensboro, Ky., cross the Kentucky and Tennessee State line in Todd County and pass thence to Nashville. A considerable amount of local aid has been secured in Indiana, conditioned on Cincinnati's subscribing $250,000—which is yet to be decided upon.

Columbus & Circleville.

This Ohio company has lately reorganized to build a road from Columbus south, about 25 miles, to Circleville, in Pickaway County, on the Cincinnati & Louisville Railroad. The capital stock is $500,000.

Junction & Breakwater.

This railroad, recently completed between Harrington and Lewes, Del., is one of the most indirect lines between two points yet constructed in a perfectly level country. The western terminus is at Harrington, on the Delaware Railroad, 63 miles south of Wilmington. Thence it extends due east nine miles to Milford, thence nearly due south 16 miles to Georgetown, the county seat of Sussex County, and thence northeast 15 miles to Lewes on the Delaware Bay just above Cape Henlopen. The distance from Harrington to Lewes in a straight line is but 24 miles; by the railroad it is 40 miles. Surveys have been made for a pier near the eastern terminus by the General Government. This will improve the harbor facilities at Lewes, from which already there is regular communication to New York by steamer. The State of Delaware holds a mortgage

for $400,000 on this road, nine miles of which (from Harrington to Milford) has been built some time, the rest only recently.

Missouri, Kansas & Texas.

On the 3d of this month the last rail was laid between Fort Scott and Parsons, connecting the Sedalia division with the line running from Chetopa to Junction City. The new route between Sedalia and Chetopa will be put in operation as soon as the ground becomes settled and the track is well ballasted. The company will then have in running order 178 miles of road from Junction City to Chetopa, and about 160 miles from Parsons to Sedalia. Eighty miles of road in the Indian Territory is graded and the track is to be layed upon it at once.

Madison County Railroad.

This is one of the oldest and least known railroads in Illinois. It extends from Edwardsville, the county seat of Madison County, westward to the Mississippi River at Edwardsville Landing, crossing the Chicago & Alton at Edwardsville Crossing, seven miles south of Alton, and is about nine miles long. This road will be sold on the 27th inst. by Robert Barth, as trustee, to satisfy a deed of trust for a hundred thousand dollars held against it by the German Savings Bank of St. Louis.

Missouri River, Fort Scott & Gulf.

In the locomotive statement of this company for the year 1870, published in the January 4 number of the Railroad Gazette, the number of miles run to one pint of oil should have been 20; and to one ton of coal, 66.3.

New York & Oswego Midland.

This company have made propositions to the Middletown & Crawford Railroad Company for a lease of their road, and the terms offered have been agreed to by a committee of the last-named company, subject to the approval of their board of directors. The board is to meet soon and take action in the matter.

Chesapeake & Ohio.

Orders have been issued by the company to let the whole line, not already under contract, on the first of April, and the western section of the road, from the mouth of the Big Sandy to the falls of the Kanawha, about 35 miles, to be completed by next July. Every effort will be made to have the whole line completed by the summer of 1872. The heavy work at the Big Bend and Lewis tunnels is progressing favorably, and in a few months all temporary tracks in the mountains will be dispensed with.

Union & Titusville.

This week this new Pennsylvania railroad was opened for business from Titusville to Union Mills. For eleven miles, from Titusville to Centreville, the new road runs by the side of the Oil Creek & Allegheny River Railroad. Thence it extends north by west through Riceville, Lincolnville, and by Oil Creek Lake, about 15 miles to Union Mills, near the junction of the Atlantic & Great Western Railroad. It has the 6 ft. gauge, from which it would appear that it will be a feeder of the Atlantic & Great Western rather than of the Philadelphia & Erie; but it is said that a third rail will be laid in the spring. It is also reported that the company designs to extend the line northward to Lake Erie and southward to Petroleum Center. The chief business of the line is likely to be the transportation of petroleum.

This road has been constructed within the past six months by J. S. & D. T. Casement, famous as contractors on the Union Pacific Railroad. The officers are: Wm. H. Abbott, President; D. H. Cady, Vice-President; D. S. Casement, Secretary and General Manager; Wm. Warmcastle, Superintendent. Directors—John Fertig, Titusville; P. G. Stranahan, Union; J. W. Doug'ass, Meadville; Henry Harley, New York City; J. S. Casement and D. T. Casement, Ohio.

Chicago & Southwestern.

The Platte City *Reveille* says that Mr. N. P. Ogden has taken a contract to complete the road from Cameron, Mo., east, 47 miles, to Trenton. The contract price is $400,000 and the work is to be done by the 1st of September next.

Fort Scott & Memphis.

This new company organized at Fort Scott, Kansas, on the 10th inst. and elected officers, as given in another column of this journal. The Fort Scott *Monitor* gives the proposed route as passing through Lamar, Barton County; Mt. Vernon, Lawrence County; Forsyth, Taney County; Isabella, Ozark County, all in Missouri, and through Mt. Olive, in Izard County; Batesville, in Independence County; Jacksonport, in Jackson County, and at the head of navigation on the White River; Walnut Camp, in Poinsett County, and Edmondsville, in Crittenden County, Ark., to Memphis, connecting Kansas with Tennessee by the most direct line. The length of the road is three hundred miles.

Wisconsin Central.

The office of Phillips & Colby, contractors for the construction of this railroad (known until lately as the Portage, Winnebago & Superior Railroad) has been removed to Room 5, Ogden's Building, northwest corner of Lake and Clark streets. As will be seen by the advertisement in another column that this firm is prepared to receive bids for the grading, masonry and bridging of the road between Doty's Island and Stevens' Point, a distance of 64 miles, until the 1st of March. Proposals will be received for the whole work or for separate sections of a mile each. Separate proposals, with plans, will be received for the construction of an iron or wood bridge with one span 150 feet long and one with 60 feet clear space over the Wolf River. Plans, profiles and specifications may be seen at the contractors' office in Chicago or at the office of the Chief Engineer, Capt. D. W. Wellman, in Menasha, Wis. The general contracting firm is as responsible as any in the country.

Boston, Hartford & Erie.

The injunction case of this railroad, heretofore issued against Jas. Alden, has been so modified by Judge Blatchford as to allow the Receiver to complete the portion he had already contracted for.

Hastings & Dakota.

The Minnesota Senate has passed a bill extending the time for the completion of the Hastings & Dakota Railroad, with an amendment making it compulsory on the company to complete twenty miles additional during the year 1871, and to include the town of Glencoe among the points through which it shall pass.

Pacific Railroad Schemes in Congress.

A telegram from Washington gives the following account of the plans to be presented in Congress this session: "No meeting of the House Pacific Railroad Committee has been called as yet. Considerable canvassing inside and outside of the House is going on as to the degree of support that shall be given either to the Senate bill or the substitute offered yesterday by Mr. Wheeler, which is, in fact, the bill agreed upon by the committee last session, but not reported. The Southern Pacific Railroad, proposed by Mr. Wheeler's bill, is about 1,300 miles in length. The Texas portion of the line will be nearly 500 miles in length, and that through the Territories about 700 miles. The total area of the land grant will be less than five million acres. The bill that passed the Senate provided for a trunk line from Marshall, Texas, to San Diego, California, the land grant for which will be about 400,000 acres more than that of the Wheeler bill, as it gives the same number of sections all through. The Senate bill provides for several branches, one being the New Orleans, Baton Rouge & Vicksburg Railroad, and another the Grand Tower & San Diego Company. The first is designed to connect the places designated in its title with the trunk line at Marshall, and the other to run from Fulton, Arkansas, to Dallas, Texas. The first road is to have the usual right of way, and for stations, etc., and five alternate sections of public lands. The other company is not to receive any grant of lands. The North Louisiana & Texas road is also authorized to connect at Marshall. The Southern Pacific, of California, is to construct a line from San Diego to San Francisco, and for this branch it is to receive the same number of sections (twenty) previously granted to the same company. The consolidation of the Vicksburg & Meridian, the Alabama & Chattanooga, and the North Louisiana & Texas railroads is provided for, and their connection at Marshall with the trunk lines. All the lands hitherto granted said companies are to accrue to the consolidation. The grants and franchises embraced in these various branches are of more value and larger extent than accrue to the trunk line under the other."

MECHANICS AND ENGINEERING.

Excavation and Embankment Tables.

The following method of making excavation and embankment tables was discovered by G. R. Nash, of North Adams, Mass., and published in the *Scientific American:*

1. Arrange the heights or depths for calculation in vertical columns, each of 27 lines.

2. In any three (3) columns, the third column is equal to twice the second, plus 81, minus the first column (where the depths increase by tenths of a foot, with 100 feet stations).

Note—

1. For shorter or longer stations than 100 feet, add the proportional part, or multiply, of the quantity required to be added for 100 feet.

2. For increasing the series of heights and depths, multiply 81 by the square of the increment in tenths, and the product will be the constant number to add.

3. Verify, in any table calculated, the last column, which proves the whole, as an error in any of the preceding columns, increases in geometrical progression to that column, and being greatly magnified, is at once discovered.

4. In compiling any table, it is necessary to calculate, by areas and distances, the first two columns, after which the table can be extended to any length by the above process.

A Safety Car-Truck.

Mr. Louis D. Boyce, of Manchester, N. Y., writes us of an invention of his own which is designed to be attached to an ordinary car-truck and to prevent great destruction of property in the event of the car leaving the track. The Rochester *Democrat* describes it as follows: "The reader will picture in his mind an ordinary car-truck, with eight wheels. Between the forward wheels are four cone-shaped wheels of less diameter, with flanges on the outside, two of which are suspended on an independent axle from each side of the car-truck, a few inches above the level of the track. One of these wheels is on the outside of the rail and the other on the inside. The small ends of the cones face each other, but are a little over the width of the car-wheel apart. Having an independent axle, they are not in motion only when the car is off the track. On both the forward and rear trucks these wheels are hung, and their positions on each side of the car and at each end are the same as described above. Now when a car-wheel leaves the track, either by reason of its breaking by a displaced or broken rail, an open switch, or turning a sharp curve, the car drops down on those cone-wheels, and they temporarily take the place of the main wheels, and the car rolls on the track as it did before. A shock will be felt by the dropping of the car which will give notice of the accident. The flanges of the cone-wheels will bind on the track and act as brakes to a certain extent."

Baltimore & Ohio Shops.

A correspondent of the *National Car Builder* gives the following account of these shops:

The paint-shop connected with the car department of the Baltimore & Ohio Railroad, at Mount Clare, cannot be surpassed by any other shop of the kind in the country. It is built in the form of an L, one wing being 375 feet long by 95 wide, and the other 225 by 90, and both 65 feet in hight, and capable of containing 35 first-class passenger cars, with ample room for the workmen. The windows are large and afford plenty of light, and the entire building is heated by steam so regulated that a uniform temperature is secured. The lower floor is divided into various departments. One of these contains two vaults paved with brick, in which the oils, paints and varnishes are kept; another is devoted to mixing paints, and another for varnishing and drying—one feature of this room consisting of a great number of little slides or drawers upon which the sash and blinds for car windows are placed, securing in this way economy of space in connection with the drying process. Other rooms are used for upholstering; and there are also separate departments for new work and repair work respectively. I might amplify upon the many details and ingenious devices in this establishment, which combine to make it one of the most complete of its kind, but I fear your space would not permit. It is sufficient to say that every modern improvement is made available that can contribute to the construction of railway cars of the best style of workmanship and finish. The cost of this shop, including machinery and fixtures, was not less than $100,000. The company contemplate erecting another very soon. Within the past year the company has turned out of their shops at Mont Clare more than a hundred new and thoroughly repaired passenger cars; and the freight-car department turns out an average of one car per day, exclusive of repairs. The blacksmith's shop is 568 feet long, 75 wide, and 60 high, and contains eight heating-furnaces, two bolt-machines, eight steam hammers, 600 to 3,000 pounds, two spike-machines, sixty forges, a rolling-mill with one eight-inch train three rolls high, and one fourteen-inch train two rolls high. The company do all their own bridge-work, make their own forgings, axles, and the greater part of the iron for their road. They also have a foundry and boiler-shop, in which are made locomotive boilers, car wheels, castings, etc. They use the Cochran patent for chilling.

The car department is under the direction of Mr. T. S. Schyack; the paint-shop is superintended by Mr. Reeves, and the upholstering by Mr. L. White. Mr. W. H. Shipley has charge of the blacksmith shop; Mr. M. Corprew, of the boiler shop; Mr. W. Cochran, of the foundry; and Mr. Samuel Husten, of the machinery. Mr. John W. Davis is Master of Machinery for the entire road, and has for some time past been engaged in superintending the construction of one of the largest

rail-mills in the country, designed to be used for making and re-rolling the rails used by this road. The number of engines on the road is 728.

Iron Permanent Way.

A system of iron permanent way has been lately patented by Mr. S. M. Guest, of Chicago, which it is intended to substitute for the wooden ties, iron rail-chains and spikes. The tie is of cast-iron, of T section, the web and horizontal face being each 6 inches broad, the horizontal face ¾ in. thick, and the web of the same thickness at the angle but diminishing downward nearly to an edge. A half chair is cast at the proper points, upon each end of the tie, so as to grasp the outside of the base of each rail. The rail is then fastened and held in place by a Z shaped piece of wrought-iron and a wrought-iron key, set on the inside of the rail. A rubber cushion, protected by a tightly-fitting iron cap, is placed under the rail, which arrangement, it is claimed, will, by diminishing the concussion, save the rolling stock and keep the ends of the rails from being beaten down. The combined tie and chairs will weigh about 120 pounds each, and the first cost of the system will be about in proportion as the cost of 120 lbs. of cast iron is to that of an ordinary wooden tie with its joints. Mr. Guest secured his patent on the 18th of last month, and he proposes to have it tried very soon on some of the Western roads.

Car Wheels and Car Axles.

A correspondent of the Boston *Advertiser* writes: "Accidents from the breaking of axles, wheels, and rails, especially during the cold weather, are becoming alarmingly frequent. Scarcely a week passes that we do not read accounts of disasters from these causes, notwithstanding the vigilance of railroad managers. No confidence is felt by railroad men in the common rigid wheel, and no well-managed road allows them to run more than fifty or seventy-five miles without being thoroughly inspected. It is no uncommon thing to find a new wheel cracked after the first fifty miles. The man or men who will give us a remedy for these evils will confer a blessing upon the traveling public, the value of which cannot be computed. The crystallization of the axle by the continual jar of the rigid wheel, coupled with the effect of low temperature, is a fruitful cause of these breakages."

Another correspondent calls attention to the manner in which axles are bought:

"The buying road perhaps stipulates for best scrap axles—and what does that mean? Hoops and sheet iron are prohibited in best scrap iron, to be sure, but the separate pieces are as dissimilar in character and temper as if composed of different metals. A soft horse-shoe, with hard steel corks upon it, lies next to an old wagon-tire, brittle from the rumble of years, and a bolt, a bar, a pin, a bit, and a worn-out shovel or scythe, all go to make up the pile that is expected to stick together with a little heat. A large part of such a mass never was, perhaps, anything but common iron, and the rest has lived and outlived its appointed days, and is ruined by the service. To heat such iron to a welding heat will seemingly improve it a little. It but little more than anneals it, and the benefit is temporary. The little new life breathed into a mass of old wrought scrap iron, by the present process of working, is never permanent; it amounts to nothing, in fact, but a means often of allowing innocent and ignorant persons the means of deceiving themselves."

According to this correspondent, "the scrap iron of thirty years ago was good, while that of the present day is very bad. The comparative freedom from accidents attended with loss of life is attributed to the fact that the strain upon axles is not ordinarily great, and that even a very poor axle may run for a long time without showing a defect. Even an axle of wood, carefully selected, might run for years, and be infinitely safer, with the thermometer below zero, than rotten iron."

Railroad Manufactures.

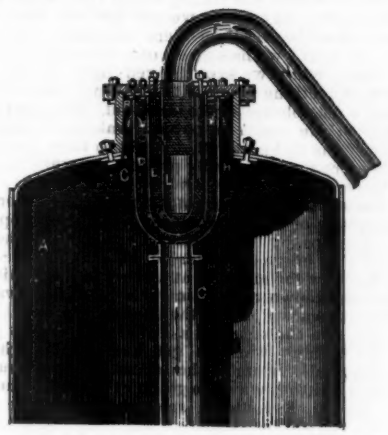
George H. Stem & Co., of Stemton, Northampton County, Pa., employ 160 men in their carworks, have three full sets of machinery, and are able to turn out twelve six-ton coal cars per day by working over time.

The locomotive works of Smith & Porter, with twenty-three dwellings adjacent, in South Pittsburgh, Pa., were burned February 7. The loss by the burning of the shops is estimated at $70,000.

Boiler Priming.

We reproduce from the *English Mechanic* a cut of an apparatus for preventing priming, which has been in operation for the last two years on board a steam-tug, and has given such satisfaction that the owners have patented it in England. With some modifications, this appliance might be used on locomotive boilers to good advantage. The writer says:

"The description is as follows: *A*, steam chest or boiler; *B*, short cast-iron cylinder bolted on ditto. To the cover of this cylinder are attached the three perforated copper cylinders, *C*, *D* and *E*; *F*, steam-pipe leading to engine; *G*, pipe leading to bottom of boiler; *H*, perforated plate.



"The action of the apparatus can be asily understood by reference to the drawing. The steam first enters through the perforated plate *H*, and follows the direction of the arrows through the perforated cylinders, *C*, *D*, and *E*, to the steam-pipe *F*, the mud and water, by its own specific gravity, passing down the pipe *G*.

"The boiler is multitubular, of the ordinary high-pressure type; diameter of shell, 6 feet 8 inches; length of shell, 9 feet 4 inches; with single furnace, 3 feet 8 inches in diameter; working pressure, 50 lbs. per square inch."

If this arrangement were used on a locomotive boiler, the steam-pipe *F* could not conveniently be carried out at the top of the dome, but by enlarging the pipe *G*, *F* could be carried down inside, and forward to the smoke-box, as ordinarily arranged. A little ingenuity would adapt it to almost any engine, and doubtless would improve some which, without it, give trouble by working water.

ELECTIONS AND APPOINTMENTS.

—J. A. Ostrander has been appointed General Ticket Agent and Auditor, and C. J. Ives General Freight Agent of the Burlington, Cedar Rapids & Minnesota Railroad.

—Charles H. Prior has been made Superintendent of the Iowa & Minnesota and Iowa & Dakota divisions of the Milwaukee and St. Paul Railway, in place of D. C. Shepard, who has resigned in order to accept the position of Superintendent of Construction of the Northwestern Construction Company. Mr. Prior has been several years a civil engineer in the service of this company, having his office in Watertown, Wisconsin.

—The following were lately elected directors of the Lafayette, Bloomington & Mississippi Railroad Company: A. Gridley, W. H. Pells, O. T. Reeves, C. W. Holder, J. E. Davis, W. L. Sullivant, J. H. Cheney, J. G. Rowland, A. B. Ives, W. H. Riggs, J. C. Bagby, Abner Taylor. The following officers were elected: President, A. G. Gridley; Vice-President, W. H. Pells; Treasurer, C. W. Holden; Secretary, O. T. Reeves; Executive Committee, A. B. Ives, C. W. Holden, J. H. Cheney, W. H. Pells, O. T. Reeves.

—E. L. Wentz, of St. Charles, Mo., has been appointed Superintendent of the Cincinnati & Indianapolis Junction Railroad in place of J. H. Sheldon, resigned. Colonel Wentz was formerly Chief Engineer and General Superintendent of the United States Military Railroads of Virginia.

—George H. Barringer has been appointed Master of Transportation of the Indianapolis, Cincinnati & Lafayette Railroad in place of H. L. Hall, resigned.

—The Sheboygan & Fond du Lac Railroad has recently changed management, and under the new one the following are the officers: T. F. Strong, President and Superintendent; A. G. Ruggles, Vice-President and Treasurer; Edwin Slade, Secretary; T. F. Strong, Jr., General Passenger Agent; L. S. Hough, Auditor and General Freight Agent; Joseph Erwin, Master Mechanic; S. M. Barrett, Traveling Agent. Mr. Barrett, the Traveling Agent, was formerly President and General Superintendent. Mr. Hough was General Ticket Agent instead of General Freight Agent, which position was accepted by C. Fairweather. The other officers are unchanged.

—Governor Claflin, of Massachusetts, has appointed Edward S. Philbrick, of Brookline, Consulting Engineer of the Hoosac Tunnel, in place of James Laurie.

—The Hartford & New York Steamship Company has chosen as directors E. T. Smith, C. H. Northam, Charles Benton and W. H. Goodspeed, of East Haddam, Ct.; Henry G. Hubbard and C. T. Browning, of Middleton, Ct., and Henry Gildersleeve, of Portland, Ct.; and the directors have re-elected E. T. Smith, President; W. H. Goodspeed, Vice-President, and A. W. Warner, Secretary and Treasurer. The company divides 5 per cent.

—The Board of Directors of the Fort Scott & Memphis Railroad Company met at Fort Scott, Kansas, on the 10th inst. and organized by electing T. L. Wilson, President; H. T. Wilson, Vice President; J. S. Emmer, Secretary, and B. F. Hepler, Treasurer. Mr. T. L. Wilson is one of those first interested in building the road from Fort Scott to Sedalia. Mr. J. A. J. Chapman, the first Chief Engineer of the Missouri River, Fort Scott & Gulf road, was appointed Chief Engineer of this company.

—Mr. Daniel H. Merritt has been appointed Superintendent of the Marquette & Ontonagon Railroad Company to fill the vacancy occasioned by the resignation of Mr. Cornelius Donkersley.

—The St. Louis *Journal of Commerce* says that Mr. H. F. Clark has been appointed Superintendent of the Toledo, Wabash & Western Railway in place of Mr. H. C. Goodell, resigned.

—Mr. Lee, the Superintendent of the St. Louis & Southeastern Railway, informs us that Mr. John F. Walsh, long agent of the Illinois Central Railroad at Ashley, has been appointed General Freight and Ticket Agent of the St. Louis & Southeastern, and will remove to the general office, No. 206 South Fourth street, St. Louis, and assume his duties immediately, succeeding Mr. George C. Morton, who has resigned.

Mr. L. B. Salisbury has been appointed Master Mechanic of the same road, in place of Archie Thomson, resigned. Mr. Salisbury entered upon his duties on the 1st instant. His office is at Mount Vernon, Ill., where the company's shops are situated.

—At the annual meeting of stockholders of the Pittsburgh, Cincinnati & St. Louis Railway Company, held in Steubenville, O., on the 6th inst., the following gentlemen were elected members of the Board of Directors: Thomas L. Jewett, Steubenville; H. J. Jewett, Columbus, O.; Thomas A. Scott, Philadelphia; Geo. B. Roberts, Philadelphia; Wm. Thaw, Pittsburgh; H. H. Houston, Philadelphia; D. S. Gray, Columbus, Ohio; Samuel T. Canby, Philadelphia; Josiah Bacon, Philadelphia; Geo. W. Adams, Dresden, Ohio; Chauncey Dewey, Cadiz, Ohio; J. N. McCullough, Pittsburgh; Joseph Means, Steubenville, Ohio. Of these Thomas A. Scott, William Thaw, H. H. Houston, and J. N. McCullough are new members, taking the places of Wistar Morris, of Philadelphia; Robert Sherrard and Thomas Means of Steubenville, and Joseph K. Johnson of Coshocton.

—At an election of the Fort Wayne, Jackson & Saginaw Railroad Company, held at Jackson, Mich., on the 14th inst., the following directors were elected: H. H. Smith, H. R. Reynolds, E. O. Grosvenor, J. F. Joy, W. D. Thompson, J. N. Bass, H. J. Rudisell, H. Bancker, A. H. Hamilton, D. Merriman, E. D. Webster. The Board then elected P. B. Loomis, President, and A. H. Edgerton, Vice-President.

—At the annual meeting of the stockholders of the Marietta & Cincinnati Railroad Company on the 15th inst., the following directors were elected for the ensuing year: John King, Jr., Johns Hopkins, R. M. Bishop, Wm. T. McClintock, J. N. Camden, Nathaniel Wright, Allen A. Chapman, Wylie H. Oldham, John Donell Smith, John Madeira, W. W. Scarborough, J. D. Lehmer, Thomas Whitridge. The only changes are the substitution of John Madeira and J. D. Lehmer for Henry C. Lord and Thomas Phillips. John King, Jr., is re-elected President; Charles F. Low, Secretary and Auditor.

—The stockholders of the Cincinnati & Baltimore Railroad Company (which is constructing the new entrance into Cincinnati of the Marietta & Cincinnati Railroad) on the 15th inst. elected the following directors: Wm. P. McClintock, Chillicothe; W. W. Scarborough, Kenner Garrard, Cincinnati; W. H. Oldham, Marietta; John King, Jr., J. Donnell Smith, Baltimore; C. Oliver O'Donnell, Columbus. Mr. McClintock was elected President, and Chas. F. Low, Secretary.

—Charles H. Chappell, who was for some time in charge of the running of trains on the Chicago, Burlington & Quincy Railroad, between Chicago and Galesburg, being stationed at Aurora, with the title of "General Agent," and whom Colonel Hammond made a Division Superintendent of the Union Pacific Railroad, has returned to the Burlington road to occupy the new office of "Master of Transportation," with headquarters in Chicago. Mr. Chappell has general direction of the running of trains, having an office in the depot.

RAILROAD GAZETTE

PUBLISHED EVERY SATURDAY.

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Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Engineering and Mechanics.—Mr. M. N. Forney, Mechanical Engineer, whose office is at Room 7, No. 72 Broadway, New York, has been engaged as Associate Editor of this journal in charge of these departments. He is also authorized to act as our agent.

Removal.—The office of the RAILROAD GAZETTE *is removed to Nos. 110 and 112 Madison Street.*

☞ *Our Prospectus and Business Notices will be found on the last page.*

THE HUDSON RIVER RAILROAD ACCIDENT.

Before most of our readers will see this number of the GAZETTE, they will have become familiar with the dreadful details of the three-fold horror which has thrown a gloom over the length and breadth of the land. In this instance it was not only one of the forms of death which we hear of so often and of which we take so little note, but the King of Terror thrice armed met the ill-fated train. His victims this time were crushed in his grasp, consumed by fire, and destroyed by flood. The thought and question which naturally arises first is, Who is to blame? a question in this case hard to answer. The daily papers, of course, teem with anathemas and are reckless with suggestions. After reading all, we put them aside with little other feelings except sorrow for the dead, sympathy for the bereaved, and admiration for the heroism of Engineer Simmons, who met death with the courage of a soldier and the fortitude of a martyr. For thrilling power, it would be difficult, we think, to find anything equal to the testimony of the fireman at the Coroner's inquest. The papers report as follows:

"Nicholas Tallon, sworn:

"I reside at No. 469 West Thirty-second street, New York; am a fireman on the Hudson River Railroad; was the fireman of the express train which ran into the oil train Monday night; we left New York at 8:06 o'clock; don't know what made us late in starting; think because we were waiting for the express car to come up the avenue; we were 22 minutes late at Peekskill; don't know how late we were at Fishkill; our engine did not steam as well as usual; it was a very cold night; it was for the want of steam that we lost our time between New York and Peekskill, though I kept my fires up as usual; we didn't stop at Fishkill; generally at Low Point we make a practice of looking at the signal light on New Hamburgh draw-bridge to see how it is situated —if it is all right; that night it signaled "all right;" coming along pretty close to Old Troy there is a kind of a little curve, and you turn out a little way; pretty near to Old Troy water tank I saw the engineer of the oil train jump from his engine with a red light; I supposed his engine was taking water; we were running pretty lively; as soon as we saw the red light my engineer blew brakes; we were running from 30 to 35 miles an hour; we had made one attempt to make up lost time; when we saw the red light, I said, 'Doc, 'there's something wrong with that draw-bridge, the draw 'is open;' he blowed brakes and said, 'Nick, put on them 'patents;' he meant the patent brakes; I pulled three yards of the bell-cord; that ought to have put them on; that's more than is usually pulled; we were now passing the engine of the oil train.

"I saw but one red light at any time; there is no certain way of telling when the patents are applied, except, perhaps, by the shock; I noticed no shock that night; the engineer reversed his engine the second time he blew for brakes; at a short notice, whistles for brakes are blown rapidly in succession; this was short notice; when we passed the engine of the oil train I got down on the step and asked Doc if he was going to get off; I didn't want to get hurt while lights were dropping all around; the speed of the train was checked a little; we were going at a little more than half speed; I couldn't see what was the matter; Doc looked around at me but made no reply, and then looked ahead again, watching his business; then I jumped, and rolled down on the ice in the creek; the next I knew I heard the crash, and saw the fire and smoke."

The simple words "Doc looked around at me but "made no reply, and then looked ahead again, watch-"ing his business," records an act which for heroic courage it would be hard to equal and impossible to surpass, and shows, as some one has said, that "there "are still giants in the land, and we should know them "if we could measure them round the heart." A deed like it is more deserving a monument than anything that is commemorated by the celebrated bronze statue which adorns the property of the company which our hero served.

So far as the evidence on the Coroner's inquest has elicited the facts, the immediate cause of the accident seems to have been the result of a combination of circumstances almost impossible for human intelligence to foresee or provide against. We say the *immediate* cause: there were other influences which contributed to bring it about, for which the company, undoubtedly, is very much at fault. If the express train had been on time, or if the accident to the oil train had occurred three minutes earlier or later, the former would have been unharmed. Had the freight car gone off the track anywhere else than on the bridge, or been loaded with anything except oil, there would have been very little, if any, loss of life. Much has been said about the negligence of the company in not having a signalman on the draw-bridge; but it is not very extraordinary that a draw which is *not used* in winter should be without a special signalman. There is very little, if any more reason for having a man on a draw which is not used, than there is for keeping watch on *any* wooden bridge; and very few roads keep a man constantly stationed at every stream which is crossed by a wooden structure. To say that the company was criminally negligent in not keeping a watchman here, because this accident happened at this place, is assuming that the officers are gifted with prescience, and can tell exactly where accidents will happen. Of course, if Superintendent Toucey had known that there would be an accident at the New Hamburg draw, he could easily have sent a man to avert it; but he could not foresee this any more than you or we can tell when the next fatal calamity will occur. Some of the daily papers have spoken about this subject as though railroad superintendents took a savage delight in crushing, burning, drowning, and maiming passengers. This, to say the least, is very thoughtless, and those who write in this way can have very little idea of the wear on the muscles, the tax on the brain, and the nervous exhaustion to which railroad managers are subjected. They are nearly all overworked, and have more to do than human nature can endure.

In the present instance, although very little of the blame can be laid on the officers or operatives, there is, nevertheless, much contributing indifference manifested in the policy of the owners of the Hudson River Railroad. There can be no excuse for a road like this, which has become one of the principal lines of travel, does as large a business and is in receipt of as much income in proportion to its length as perhaps any other road in the country, not adopting every means to insure safety which is known to the science of railroad management and operation. When those who control the road voluntarily increased its stock, it is a fair inference to suppose that they felt able to pay a dividend on the whole amount. Such action is an acknowledgement that the company is pecuniarily able to make such improvements as experience and existing practice have shown to contribute or to be necessary to secure safety. That its road in its equipment is not up to the standard of first-class roads, the existence of the combustible New Hamburg and numerous other bridges abundantly testify. When, however, regard for human life gives place to lust for gain, and when the risks which can be laid upon those who travel—including you and I, reader—are hypothecated as collateral for additional stock dividends, it is not strange that improvements which "theoretical" men would suggest are disregarded.

When some unhappy wretch of a switchman or engineer, with his life in his hands, in an unguarded moment displays the wrong signal, or fails to observe the right one, there is no condemnation heavy enough to heap upon his head; but when the respectable owners of the road, in their comfortable office, "deliberately" determine that much needed improvement shall not be made because it might prevent a rise or fall in the value of their property, such men usually go uncondemned. The switchman might be pardoned (but not reinstated), the engineer pitied; but, certainly, if just wrath is ever called for, it is when such deliberate disregard for human life is manifested as is often shown in the neglect to make provision or expend money to make travel more secure. Legislative protection from such culpability is hopeless, until our legislators can be composed of wiser men than it is possible to elect under our present system. Nearly all our laws to protect the public from railroad companies have thus far been almost entirely futile, chiefly, we believe, because the persons who framed them were ignorant of the subject on which they legislated. No compulsory remedy is therefore possible, and it is only as prevailing public sentiment may influence those at fault that the evil can be reached at all.

A road like the Hudson River should be equipped with every appliance for safety which science and experience can suggest, and no reasonable expense should be spared in finding out what is safest.

It seems to be a little doubtful whether the car of the oil train was thrown from the track by the breaking of the axle, or whether the axle was broken by the car running off. Be that as it may, it is none the less true that the breakage of axles is entirely too frequent. We hear such accidents spoken of as though they were mysterious visitations of Providence, and not as though they were always evidence of gross neglect or ignorance somewhere. We have recently written about this subject, and spoken of the importance of statistics and experiments. Who will be the first to give us accurate data? When axles frequently break, it shows clearly they are not strong enough; and when, in a very great majority of cases, they break at one particular place, it is clear they are not strong enough at that point.

As we mentioned before, the daily papers in New York fairly overflow with suggestions and remedies to prevent such accidents in future. One man wants to compel railroad companies to put two brakemen on each passenger car, not knowing, probably, that one man now puts on both brakes at the same time. Another correspondent would allow nothing but iron sleeping cars on any road. Mr. Goodrich has introduced a bill into the Legislature forbidding the carrying of petroleum in anything but wrought iron tanks, one-quarter of an inch thick, cylindrical in form, and hermetically sealed. If he had also specified that their capacity should not exceed twenty gallons, it might be a good precaution. Mr. Fiske wants it carried in barrels or casks "hooped with iron." Mr. Pierce wants to impose a penalty for locking railroad car doors. An anonymous correspondent proposes to supply all trains with the United States Fire Extinguisher. The *Times* editorially proposes to overhaul the whole signal system of American railways. (Good; but who is to do it?) A correspondent in the same paper wants each car to be provided with two buffers and a tight coupling. A *Tribune* correspondent would have all trains supplied with rockets for danger signals, a suggestion not altogether without reason. Another wants a man located on the tender with his back to the engine to watch the other end of the train, Camden & Amboy fashion. Another proposes that the head-lights of locomotives should be arranged so that by pulling a cord they can be instantly changed to a red light,—also not a bad suggestion. A Providence man calls attention to Whitworth's plan of boring a hole through the center of axles to detect flaws. Mr. Ray has introduced a bill into the Legislature with the following provisions:

"It provides that it shall not be lawful for the president, directors or executive committee of any railroad company doing business in this State to declare or pay any dividend or interest, or cancel or pay any of the principal of any stock or scrip, certificates or other evidences of indebtedness which do not represent capital actually subscribed for and paid into the

treasury of the company, and which has been actually expended in the construction or equipment of the road, until it has substituted iron bridges in all places where wooden bridges are now in use. The expenses incurred in the construction of the bridges must be paid for out of the surplus earnings of the roads, after the necessary expenses of operating and maintaining them shall have been provided for, and the payment of seven per cent. per annum on the amount of their funded indebtedness, and seven per cent. annual dividend on the amount of their capital, which amount shall be determined by their annual report made to the State Engineer September 30, 1870, except in the cases of the New York Central, Hudson River, and Erie railroad companies, whose capital stock entitled to dividends under the act shall be determined and limited to the amount of stock represented by these companies in their report to the State Engineer and Surveyor for the year ending September 30, 1866. Transportation of petroleum, coal oil, or other explosive or inflammable fluids, except in tanks made of the best quality of boiler iron, is prohibited, and any train carrying any explosive or inflammable material is prohibited from moving at a higher rate of speed than ten miles an hour. Each freight train must be furnished with patent safety brakes, so that it can be stopped at any time within twenty rods of the place where the brakes are applied. It also declares it to be unlawful to permit the doors of any car or coach to remain locked while a train is in motion. On freight trains the company is required, by the act, to have a brakeman at every interval of seven cars. Until the bridges provided for by the bill shall have been created, trains are prohibited from passing over any swing or draw-bridge without first coming to a full stop, and no train shall be allowed to cross any bridge before slackening its speed, or more than one train to be on any one bridge at the same time. Damages for accidents are to be determined by trial by jury, and $25,000 is fixed as the maximum sum that can be recovered for a single life lost.

"The penalties for every violation of this act are exceedingly severe."

It will be "a good thing" to be on the committee to which this bill is referred. Senator Parker offered a resolution, which was adopted, directing the Railroad Committee of the Senate to investigate the facts attending the accident, and ascertain whether the bridge where it occurred was substantially built, and whether other bridges on the same road are in a safe condition, the committee to be empowered to send for persons and papers. This is the nearest approach to the only thing which can be effectual in preventing accidents. It is daily becoming more apparent that the interests of the railroad companies themselves and of the whole country demand that some body of competent men should be organized to make investigations of this kind, to conduct experiments, to collect statistics, and to have authority to send for persons and papers. Such a board to be of any use *must* be composed of some of our ablest engineers and most experienced railroad managers, with a ballast of good financiers to steady it. The manner of organizing and appointing such a board is attended with many diffiulties. One thing is certain, that universal suffrage, if applied to this problem, will not solve it.

THE PITTSBURGH, CINCINNATI AND ST. LOUIS RAILWAY.

This company held its annual meeting in Steubenville, Ohio, on the 6th inst. Owing to the ill-health of the President, Hon. Thomas L. Jewett, who was attacked and partly disabled by paralysis a few months ago, the administration of the company's affairs has been for the most part entrusted to the Vice-President, Hon. Hugh J. Jewett. But sudden illness prevented the attendance of the Vice-President, and on that account the presentation of the company's annual report, which he was preparing, was postponed until the next meeting of the Board of Directors. A summary of statistics was presented, however, from which we copy the following:

PITTSBURGH & COLUMBUS DIVISION.

Earnings	$2,821,194 64
Expenses	2,095,009 80
Net earnings	$726,114 84

"The operating expense is 74 26-100 per cent. of the earnings. There is included in the expenses of this year $135,351 which is properly chargeable to 1869, which amount deducted from the expenses of 1870 makes the working expense 63.60 per cent. of the earnings.

"The earnings per mile are $14,617.

INDIANAPOLIS & CHICAGO DIVISION.

Earnings	$3,507,550 13
Expenses	2,834,152 02
Net earnings	$672,393 11

"The operating expense is 80 82-100 per cent. of the earnings, against 93 35-100 per cent. for 1869. The earnings per mile are $5,974.

LITTLE MIAMI DIVISION.

Earnings, thirteen months	$2,024,675 49
Expenses	1,257,938 72
Net earnings	$766,736 77

"The operating expense is 62 per cent. of the earnings, against 65 per cent. for last year.

"The earnings per mile are $10,330. We have paid upon the Little Miami lease and rent account as follows:

Annual lease, 8 per ct. on $6,000,000	$ 480,000 00
Little Miami & C. & X. Express	7,500 00
Interest on bonds, etc	174,205 36
Total	$ 661,705 36
Government tax on dividends	$ 12,409 37
Total	$ 674,114 74

NET EARNINGS.

"The following is a summary of the net earnings:

Pittsburgh & Columbus Division	$ 726,114 84
Indianapolis & Chicago Division	672,393 11
Little Miami (13 months) Division	766,736 77
Grand Total	$2,165,249 72

The Pittsburgh & Columbus Division, has 193 miles of road, the Indianapolis & Chicago Division which in this account seems to include the 314 miles from Columbus to Chicago, the 105 miles from Bradford Junction to Indianapolis, the 102 miles from Richmond to Anoka and the 61 miles from Logansport to the Illinois line—that is all of the Columbus, Chicago & Indiana Central Railway—has 582 miles. The Little Miami Division has 197 miles of road.

The first division named has a very heavy traffic, it will be seen, while the second has a very light traffic—only $6,000 per mile—although that part between Columbus and Indianapolis, nearly one-third of the whole, is a very busy line, carrying a very large part of the traffic between St. Louis, Indianapolis and Louisville and the East.

The proportion of expenses to earnings on the Pittsburgh & Columbus Division appears large, yet it leaves net earnings of about $3,700 per mile, which is a satisfactory return on the capital invested; the truth is that when a road has a very heavy traffic, though it is easy to make the expenses light for the amount of business done, yet the proportion of expenses to earnings is likely to be large because of a reduction of rates. A company can make just as much at a profit of five cents a ton when it carries ten million tons of freight yearly as it can at ten cents a ton when it has but five millions.

But if the proportion is kept up by low rates on this division, it is by light traffic that it is made the formidable figure of nearly 81 per cent. on the Indianapolis & Chicago Division. This leaves net earnings per mile less than $1,200.

The Pittsburgh, Cincinnati & St. Louis Company pays 30 per cent. of the gross earnings of this division as rental to the Columbus, Chicago & Indiana Central Company. This 30 per cent. for the past year amounts to about $1,050,000, which is more by $380,000 than the gross earnings of the division. Moreover, it guarantees the interest on $15,821,000 of the mortgage bonds of the Columbus Company, whether or no the 30 per cent. is sufficient therefor. This year the 30 per cent., as we have seen, is but $1,050,000, while the guaranteed interest on the bonds amounts to $1,107,000. So it appears that the Panhandle Company loses $435,000 this year in operating the Columbus, Chicago & Indiana Central Railway.

But even in this statement a favorable view can be taken. For though the expenses were 81 per cent. in 1870, they were 93½ per cent. in 1869; and though the gross earnings were less by $22,000 in 1870, the net earnings were greater by $650,000—in fact were nearly ten times as great; for in 1869 the net earnings of these 582 miles of railroad (besides, we believe, the rental of 25 miles between Cambridge and Rushville in which this company has a half interest) were less than $76,000! Moreover, during the past year the lessee has obtained more favorable terms.

The prospect for the current year, we should say, is quite favorable. The St. Louis business, now large, is still growing, and an increase may reasonably be looked for on the other lines. Moreover, it is to be hoped that fair prices may be received for transportation throughout this year, which was not the case for nearly or quite one-half of last year.

British Railroad Traffic.

The report of the British Board of Trade (a department of the government, and not a voluntary association like the "boards of trade" common in America) on the railroads of Great Britain and Ireland for the year 1869 has recently been published. Some of the statements will be of interest in this country, though our lack of any complete statistics of our railroads renders it impossible to make exact comparisons.

By this report it appears that in 1869 there were 10,773½ miles of railroad in England and Wales. (Just about twice the present mileage of Illinois in just about an equal area.) Scotland, about the size of the State of Maine, (31,000 square miles), had 2,397 miles of railroad, and Ireland, about the same size, (32,000 square miles) had 1,975 miles of road.

On the 10,773½ miles of road in England and Wales the total receipts for traffic were about $180,000,000, or nearly $16,500 per mile. The railroads of New York in the same year earned nearly $11,000 per mile. The Scotch railroads earned about $9,000 per mile, and the Irish lines but little more than $5,000 per mile.

About 45 per cent. of the receipts of the lines in England and Wales was from passenger traffic. The proportion of this traffic on the Scotch lines was about 38 per cent., and on the Irish lines about 60 per cent. In New York 29 per cent. of the receipts were from passengers, 66 per cent. from freight, and 5 per cent. from other sources.

On the English and Welsh lines out of 232,000,000 passengers carried less than one-tenth were first class, a little more than one-fourth were second class, and the rest—nearly two-thirds—were third class. There is no record of the classes of passengers on the New York railroads, but most of the railroads have but one class of passenger cars; while on those which have first and second-class cars, and also drawing room or "palace" cars, there must have been vastly more first-class than second-class passengers, while those carried in "palace" cars (which are really equivalent to the English first-class cars) were probably a fraction of the number of first-class, few taking such cars except for a night journey, or for one that continues throughout the day.

Regulation of Freight Tariffs.

As we go to press we have received from our Springfield correspondent an abstract of Fuller's Bill No. 166 (Senate) "to prevent unjust discriminations in rates charged by different railroads," etc.

Section 1 of this bill provides that no railroad corporation shall charge "for the transportation of goods, "merchandise or property on its said road, for any dis-"tance, any larger or greater amount as toll or com-"pensation, than is charged or collected for the "transportation of similar quantities of the same "class of goods, merchandise or property over a "greater distance upon the same road. Nor shall any "such railroad corporation charge or collect for the "transportation of goods, merchandise or property "over any portion of its road a greater amount as toll "or compensation per mile than shall be charged or "collected per mile by it for transportation of similar "quantities of the same class of goods, merchandise or "property, over any other portion of its road of equal "distance," and all contracts at greater price are declared void.

Section 2 defines "railroad corporations."

Section 3 commands that "no railroad corporation "shall increase its rates of toll or compensation to be "charged for the transportation of any property from "any point on its line of road to any other point on "its line of road, by reason of any decrease in its rates "which may be required to be made under the first sec-"tion of this act; nor shall the rates of toll or com-"pensation on any day hereafter charged or collected "for transportation of any property, from any point "on its line of road to any other point on its line of "road, be greater or more than that charged or col-"lected on the same day and month in the year 1870, "for the transportation of similar quantities of the "same class of property over the same part or portion "of said road."

Section 4 makes the penalty against the company and officers for violation of provisions of this law $1,000 and a reasonable attorney's fee.

Section 5 makes wilful violation of the law by a railroad company work a violation of its charter.

In presenting this bill Mr. Fuller said that this was probably all the legislation for the regulation of freight transportation that his company would present this season, as the labor necessary to prepare a bill establishing rates for freight was entirely too great to be completed before the close of the session.

We are informed that a strong effort will be made to introduce some important modifications into the passenger tariff bill, known as the "three-cent bill," which has passed the Senate.

The Ohio Commissioner's Report.

We have received, too late for the extended notice which it deserves, the first volume of the annual report of the Commissioner of Railroads and Telegraphs of the State of Ohio. This volume, which contains 667 large octavo pages, is a compilation of the laws of Ohio and of Congress relative to railroads and telegraphs, the charters of the various companies of Ohio, with notes of decisions, etc. This description of the contents is sufficient to show that the volume must be exceedingly valuable. The Commissioner, Mr. George B. Wright, has been a very useful officer, to whom the community at large, as well as the people of Ohio, are greatly indebted, he having obtained, compiled, collated and published statistics and other information of the

highest value, which only such an officer has the means of acquiring. We have published copious extracts from Mr. Wright's reports of former years, which have been widely read and much valued. The present volume is valuable chiefly for reference, but the second volume of the report, soon to be published, will give the usual full statistics of the Ohio railroads, with discussions of questions of importance, and we shall be glad to present our readers with the most important parts of it.

A St. Louis Rumor.

There was a report one day this week that Mr. Hudson E. Bridge had $900,000 of the stock of this road for sale; that Mr. Joy was trying to buy it, probably for a St. Louis outlet to his Kansas roads; that Mr. Parsons, President of the Missouri, Kansas & Texas Company, was also trying to get it, in order to secure the road as an outlet for his system of roads, for which it would be exceedingly convenient, and that he was backed by the Pennsylvania Company, which would be glad of a line to complete the connection between the Kansas Pacific and the Vandalia road, both of which it controls; but that James Fisk, Jr., of the Erie had secured it, for what purpose did not clearly appear.

But just as we had exhausted ourselves by congratulating the successful and condoling with the unsuccessful, another report comes which declares unequivocally that Mr. Fisk hasn't bought the road, nor Mr. Parsons, nor Mr. Joy; that, in fact, Mr. Bridge don't want to sell his stock, and that if he did he wouldn't let outside barbarians have it, but grant to Missourians only, and especially to St. Louisans, the privilege of purchasing. "He will, however," says this last report, "divide his "large interest so that the burden of carrying the floating debt of the company will be borne equally by "other parties; but the control and management of it "and the road will remain in his hands."

Which is better.

"Protection for Civil Engineers."

A letter from Mr. T. J. Nicholl, which we publish on another page, is commended to the attention of engineers. Any legislation necessary either for the protection of the engineers or of the public, can probably be obtained without difficulty, if the engineers believe that it is needed and make known their belief. But the Legislature is not likely to, and should not, enact a law until the engineers have made something like a general expression on the subject. A vague impression that engineers would like certain laws will not justify the Legislature in making them. To have for the asking is usually considered very easy terms, but engineers, like other people, must take the trouble to ask if they want anything. A plan can be very easily matured, if those who are interested in the subject will put themselves into communication with Mr. Nicholl and with each other.

The Union Pacific Bonds.

It is reported that the Judiciary Committee of the Senate are almost unanimously of the opinion that the decision of the Attorney-General, that the company is bound to pay the interest on its second mortgage bonds guaranteed by the government as fast as it accrues, is not in accordance with the law and the understanding of it in Congress when it was passed. It holds, also, according to this report, that the government has no right to withhold the payment of more than fifty per cent. of the charges against it for transportation. The committee, it is said, will propose some legislation for the relief of the railroad, explanatory, probably, in its nature, and a correspondent says that it will "also give "the Secretary of the Treasury some positive instruc- "tions as to his course hereafter on this question," though how a Senate committee can give instructions to an administrative officer, we do not clearly see.

Eminent Domian.

The St. Louis *Republican*, commenting on the article on eminent domain by Hon. Elliott Anthony, which we published a few weeks ago, calls to mind two Missouri cases, recently cited by the Attorney-General of that State in an opinion on some plan for taxing railroads. In these cases the United States Supreme Court decided that constitutional conventions are as much bound as State Legislatures by the provisions of charters which partake of the nature of a contract. The *Republican* adds:

"The right of eminent domain reserved by Illinois over her railways would have existed without any such reservation, and will practically mean that the State can condemn a railway franchise just as it can any other species of property—on paying for it. The caution of the Legislature in granting franchises should not be relaxed from any notion that by some legerdemain of eminent domain it can revoke them at pleasure. If railways and other great public works owned by private corporations are ever to be regulated by legislative authority, it will more probably be through the incontestible and equally 'sovereign' right of general police. Even that should never be exercised so as seriously to impair the value of a franchise in which individuals have invested their money in good faith."

The truth is the State, like an individual, cannot compel a person or company of persons to give back what it has once given to them; though, unlike an individual, it can compel them to sell it whatever it considers necessary for public purposes.

Mr. Fairlie's Letter.

We publish, in another column, a letter from Mr. Fairlie in continuation of a discussion on narrow-gauge railroads. It reached us so late that we were unable to make any comment on it this week, but will give it the attention it deserves in our next number.

In this connection, we take occasion to say, that we have received a private letter from Mr. Fairlie, in which he discusses the peculiarities of his locomotive as compared with the Seraing engine, which Mr. Evans thought so wonderfully like the Fairlie. Mr. Fairlie shows that his engine is so made as to be remarkably flexible, notwithstanding its great length; wherein it differs radically from the Seraing engine, which is exceedingly rigid. We intend to explain these differences by the help of drawings hereafter.

ERSONAL.

—William B. Ogden was last week elected President of the American Institute for the current year.

—The Springfield *Republican* makes the following commentary on the "rise and progress" of a well-known New England railroad officer: "Mr. J. B. Chapin, Assistant Superintendent of the Boston & Albany Railroad, with whom thousands of persons are casually acquainted, received the appointment of conductor on the way passenger train on the Western road in 1839, running from Albany to Springfield and returning daily. After a year's service he resigned and went West, and upon his return was reappointed to his old position, and from 1841 to 1866 was the indefatigable servant of the railroad company, running his train 200 miles per day. In 1866 he was appointed Assistant Superintendent of the division of road between Albany and Pittsfield, and sent east from Albany 41,149 cars of freight that year; in 1867, 44,177; in 1868, 52,846; in 1869, 69,434. In 1870, 146,000 freight cars passed over the bridge at Albany, of which 84,255 were under Mr. Chapin's supervision. He is one of the most capable and efficient officers connected with the Boston & Albany Railroad."

—Mr. James Robb, of the banking firm of James Robb, King & Co., has been elected a director in the Hannibal & St. Joseph Railroad Company, in place of Mr. Blacke, of Boston, resigned. Mr. Robb was at one time President of the Chicago & Alton Railroad Company.

—Mr. S. T. Emerson, who was last month appointed Chief Engineer of the North Missouri Railroad, has been kindly remembered by his old friends, the employes of the Illinois Central Railroad, who have presented him with a beautiful gold watch and chain costing $325.00. Mrs. Emerson also received a silver tea set, of 25 pieces, costing $200.00.

THE HAMBURGH DISASTER.

Chicago, February 15, 1871.

To the Editor of the Railroad Gazette:

The accounts of the late disaster upon the Hudson River Railroad, in reproducing with painful minuteness the horrors of the fearful calamity, in many instances seem to gloat upon the details, and find a pleasure in charging incompetency, neglect, and cruelty upon innocent parties.

If there has been aught of neglect, or carelessness, upon the part of the managers of the road, the facts will undoubtedly be elicited in the investigations now progressing, and the premature decisions already formed are as unjust as ungenerous. To believe that the management of the road has been guilty of many of the charges preferred against them by sensational Bohemians would be the height of absurdity. Apart from any considerations of humanity, the requirments of ordinary commerce would exact of them care and forethought (claimed to be lacking,) in order to secure a financial success.

The facts thus far shown, would seem to class it among the unavoidable accidents, as unforeseen as fatal. Axles have broken when surrounded by all the precautions that care and experience could suggest, and may again under similar circumstances, so that no blame could attach to that particular feature of the disaster; but it does seem that if the train had been equipped with a proper working brake, the fatality could have been avoided, or to a great extent mitigated in its horrors.

If the Creamer brake, said to have been in use upon the train, is so complicated in its character or requires such a nicety of adjustment as to render it liable to fail when most needed, it would seem to be utterly worthless as a safety appliance.

The statements given seem to indicate that the express train was at least one thousand feet from the wrecked oil car, when the first blast for brakes was given. Had the train been equipped with the Westinghouse brake, the engineer could have readily stopped his train, as the instances are numerous of express trains quite as heavy as this, and moving as rapidly, being stopped with ease inside of seven hundred feet.

Hand brakes for the control of express trains are among the things of the past, and in procuring a substitute for them, the principle requisite is such simplicity of construction as shall insure a *certainty* of action when they are most needed. With a general knowledge of all the different improved brakes now in use, the writer knows of no system so thoroughly combining ease and efficiency of operation with durability and simplicity of construction as the Westinghouse. So well known are the facts, that upon roads where they are in use, the engineers assert that they would prefer to bear a large proportion of the expense of the equipment rather than to be without them, and when the knowledge shall be as general among the traveling public, railway managers will hesitate to risk disaster without them, which might be obviated in their use.

Secretary.

Protection for Civil Engineers.

Kankakee, Ill., Feb. 13, 1871.

To the Editor of the Railroad Gazette:

Since writing you on the above important subject, I have conversed with many of our leading engineers, and gentlemen connected public works, and, without an exception, all were pleased with my propositions and considered it of the greatest importance that they should be acted upon as soon as possible.

The letter appearing in your issue of the 4th inst., signed "Practical," is very much to the point, and the suggestions offered are just and proper. I would respectfully invite correspondence from all interested in this matter, informing me of their ideas regarding the calling of a convention.

Many other suggestions could be made on this subject, but it unnecessary here, as they can be brought before a convention to better advantage.

T. J. Nicholl,
Engineer Plymouth, Kankakee & Pacific Railroad, Hennepin, Ill.

Chicago Railroad News.

Illinois Central.

A new steamer is building for the company, to run between Cairo and Columbus. She will be named "Illinois," and it is claimed will be able to make the trip from Cairo to Columbus in one hour, and return in one hour and fifteen minutes. She will be completed and ready for service by the 15th of March.

Railroad men will be generally surprised to learn of Mr. Marvin Hughitt's resignation of the office of General Superintendent. Mr. Hughitt is still a young man, though he has been long in the service of the company—for the last five years holding the position he has just resigned, and to which he was appointed on the resignation of Mr. Arthur. In 1865 and 1866 he acted as Assistant General Superintendent of the company, before that time having been successively Train Master and Superintendent of Telegraphs. Previous to his connection with the Illinois Central Railroad, Mr. Hughitt served for a short time on the Ohio & Mississippi Railroad, and for a much longer time was connected in various capacities with the Chicago & Alton Company.

Chicago & Alton.

The contractors for grading and bridging the Louisiana Branch, which runs from Roodhouse, twenty-one miles below Jacksonville, on the Jacksonville Division, west to the Mississippi River at Louisiana, have 1,000 hands at work, and expect to complete their contract by next June. The Superintendent, McMullin, is now at the East, purchasing—according to the St. Louis *Republican*—fifteen new locomotives.

Chicago, Burlington & Quincy.

The company has made arrangements for close running connections at Burlington with the newly-completed Burlington, Cedar Rapids and Minnesota Railroad, and have agreed to set aside 50 per cent. of the gross earnings realized from its business for investment, at par, in the bonds of the Cedar Rapids Company.

A circular from the General Superintendent, dated the 13th instant, announces the appointment of E. S. Washburn as Contracting Freight Agent for the road, with office at No. 63 Clark street.

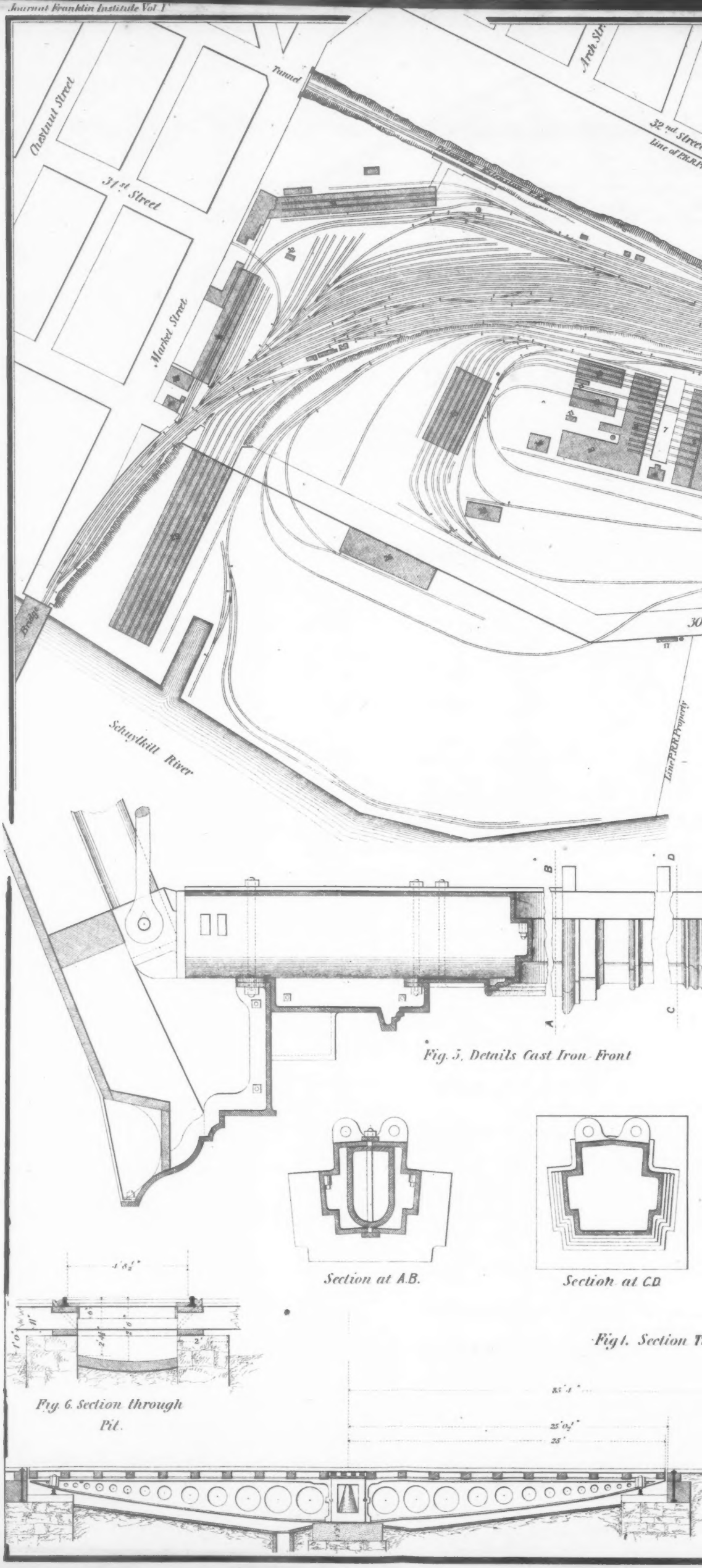

Fig. 5, Details Cast Iron Front

Section at A.B.

Section at C.D.

Fig. 6. Section through Pit.

Fig 1. Section T

PENNSYLVANIA RAILROAD SHOPS

WEST PHILADELPHIA.

LITH. JAS. Mc GUIGAN, PHILA.

Scale Feet. 100 200 300 400 500 600 700 800

32nd Street

Line of P.R.R. Property

Race Street

Powelton Avenue

Line P.R.R. Property

Bridge Street

Bridge

Proposed Suspension Bridge

Proposed Over head Bridge

30th Street

Lombard

Line of P.R.R.

References.

1 Locomotive House
2 Locomotive Shop
3 Blacksmith Shop
4 Boiler Shop
5 Store House
6 Oil House
7 Transfer Table & Pit
8 Shop Offices
9 Passenger Car Shop
10 Blacksmith Shop
11 Water Closets
12 Wood Working Machine Shops
13 Paint Shop
14 Coal Houses
15 Freight Car Repair Shop
16 Steam Pump & Well
17 Steam Pump & Well
18 Reservoir
19 Carpenter Shop
20 Stable
21 Coal Platform
22 Machine Shop
23 Locomotive House
24 Stable
25 Lumber Shed
26 Oil Shed
27 Offices Transportation. Dep.t
28 " " " "
29 Grain Depot
30 Pennsylvania Passenger Depot
31 New York Passenger Depot
32 Gas Supply House for Pass.r Cars

Top of Rail
Upper Flooring
Sub Flooring

Fig 7. Cross Section through Turntable at centre.

6" Beam
1 1/2" diam
2 Rods, 1" diam
2 Rods, 1 1/4" diam
1 1/2" diam
2 1/4" diam
2 1/4" diam
2 Rods, 1 1/2" diam

Scales

Figs. 1, 2, 3. Feet
Figs. 4, 5. Feet
Figs. 6. 7. Feet.

nt C.D

. Section Turntable & Locomotive House

61' 8"

42' 6"

PENNSYLVANI

WEST P

IOPS

Feet.

Bridge Street

head Bridge

Proposed Iver

PENNSYLVANIA RAILROAD SHOPS

WEST PHILADELPHIA.

LITH. JAS. Mc GUIGAN, PHIL.a

Plan of Locomotive House

Scale

Feet.

Roof Truss

Entrance Track

Pit

Pit

Rails laid on Cross ties imbedded in stone ballast

Stone Ballast 14" deep

Sewer

Turntable

Pit

Foundations

Water Pipe

Sewer

Sewer

Construction Dep.t Penn.a R.R.

PENNSYLVANIA RAILROAD SHOPS

WEST PHILADELPHIA.

LITH. JAS. Mc GUIGAN, PHIL.a

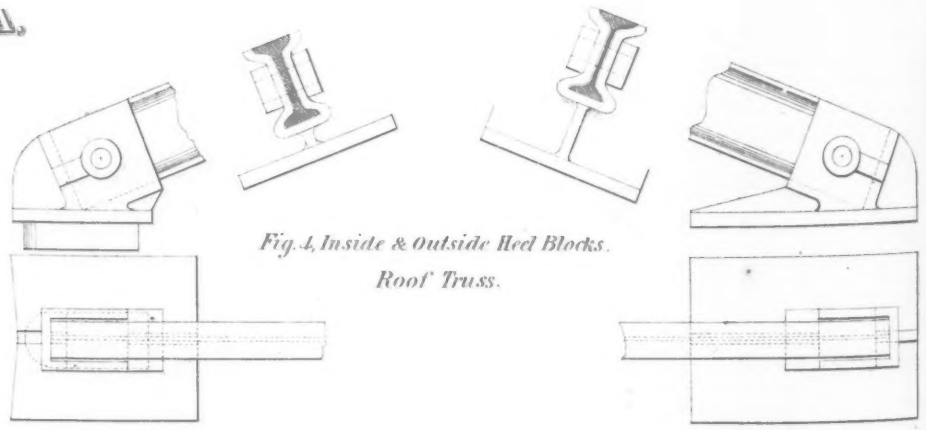

Fig. 4, Inside & Outside Hed Blocks. Roof Truss.

Feet

Feet

61' 8"

42' 6"

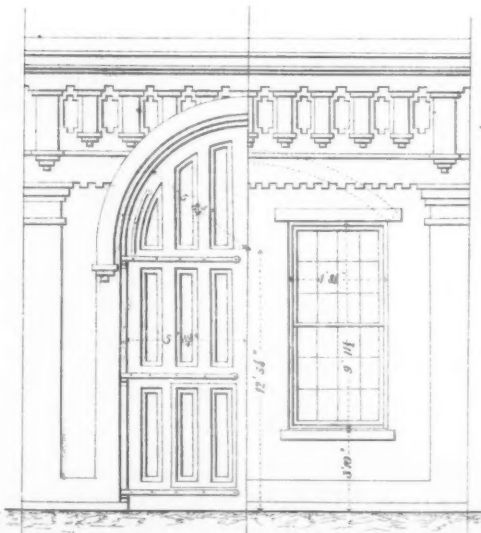

Fig. 2, Panel Outside Wall.

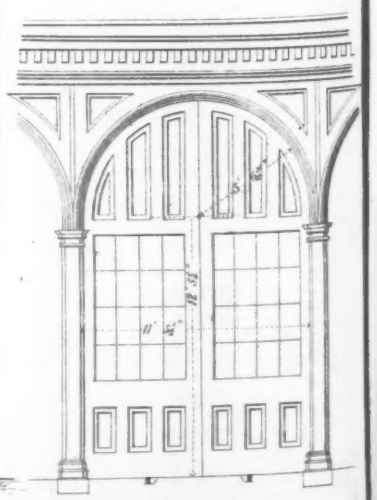

Fig 3. Panel Inside Front

Construction Dep.t Penn.a R.R.

The Pennsylvania Railroad Shops at West Philadelphia.

BY JOS. M. WILSON, C. E.,

Principal Assistant Engineer, Construction Department, Pennsylvania Railroad.

The Pennsylvania Railroad Company possess large constructive and repair shops on their main line at West Philadelphia, Harrisburg, Altoona and Pittsburgh. Those at Altoona are the most extensive, having grown up with the road from its commencement; and it is at this point that the heaviest work is done. The West Philadelphia shops, although considerably smaller, attract much interest, however, as probably showing the best general arrangement and details of construction of any owned by the company, since they have been designed as a whole, and all built within the last eight years. With this view, we hope the following description of these shops will not prove unacceptable.

Plate 1 gives the eastern part of the West Philadelphia yard, showing not only the position and grouping of the new shops proper, but also the arrangement of all the track, the passenger depots, offices, and other buildings belonging to the company at this point. Those marked from 1 to 18 inclusive comprise the new shops; and it is only these that we propose describing in detail. This yard, including a portion not shown here, contains $4\frac{3328}{5280}$ miles of single track in main line, and 22 miles in sidings and shop tracks, making a total of $26\frac{3328}{5280}$ miles of single track. It has a double track connection over Market Street Bridge with the freight depots of the company, situated on the east side of the Schuylkill River, also a connection, *via* Delaware Extension of Pennsylvania Railroad, with a grain elevator and coal wharves on the Delaware River, the City Gas Works at Point Breeze, and the Philadelphia, Wilmington & Baltimore Railroad. In a portion of the yard west of Bridge street, and not shown on plan, it has a connection, *via* Junction Railroad, with the Philadelphia & Reading Railroad, and *via* Connecting Railway, with the Philadelphia & Trenton Railroad, to New York. Thus it will be seen that the facilities for transfer and running of through trains are very great. The grade, crossing at Bridge street, now the only one in the yard, will shortly be superseded by an overhead bridge, doing away with a source of danger to the public, and allowing of uninterrupted movement of trains.

The group of buildings marked 22 and 23, consist of a locomotive house and machine shop, built some years ago, when this part of the road belonged to the State, and do not merit attention. The grain depot, No. 29, has been but recently erected, and is for the accommodation of the city or local trade only. The office buildings, Nos. 27 and 28, are occupied by that portion of the transportation department managing the Philadelphia Division of the road. The passenger depot buildings are only temporary, and in the course of time it is expected that a large, commodious depot will be erected, containing all the requisite comforts and conveniences for the proper transaction of business and the needs of the traveling public. The gas supply house, No. 32, is a small building, containing an engine and pump for the compressing of illuminating gas, obtained from the city works, into receivers, for lighting of passenger cars.

Having given a general outline of the more important matters of interest connected with the location of the new shop buildings, we will now proceed to take up each building in order as numbered in table of refersnces, plate 1, and describe it in detail.

Locomotive House.—The locomotive house is a regular polygon in form, of forty-four sides, having an inner, open court, in the center of which is a turn-table. From this table diverge forty-four tracks, thus affording accommodation to that number of locomotives. Plate 2 shows a plan of one-fourth of the building. Considering the house divided into forty-four stalls, one for each track, as these stalls are all similar, advantage is taken of this in the plan to show a different stage of the work in each stall. Thus we have successively, the foundations, the same with wall plates laid, the floor joist, a stall floored over, etc., etc. On plate 3 are given details of various parts of the building.

Fig. 1 is a vertical section through turn-table pit and building.

Fig. 2 shows a panel of outside wall, one-half representing part of an entrance door and the other half a window.

Fig. 3 show a panel of the inside front and the door for the same.

Fig. 4 gives inside and outside heel blocks of roof truss.

Fig. 5 shows details of cast iron inner front.

Fig. 6 is a cross section through a pit in one of the stalls.

Fig. 7 is a cross section through turn-table at center, showing arrangement of rollers.

The diameter of the building from out to out is 300 feet, and that of the inner court is 168 feet 11 inches. The clear width in the interior, from inside to outside wall, is 62 feet 10 inches, and the height, from the top of rail to the tie rod of roof truss at heel blocks, is 21 feet 9 inches. Of the forty-four tracks contained in the building, two are entrance tracks. All, except these entrance tracks, have pits 42 feet 6 inches long by 3 feet 11 inches wide, 2 feet 9 inches deep at front and 2 feet 6 inches deep at back. These pits have stone side walls 2 feet thick, and are paved with brick, laid on edge and grouted with cement. They drain into a sewer at their end, as shown on plan, plate 2. There is a sheet iron smoke flue for every track, placed directly over the position of the smoke stack of the locomotive when in place. Ventilators are placed in ridge of roof on every alternate stall.

The foundations of the building are of stone, the outer walls being 2 feet 6 inches thick, and all inner walls 2 feet thick. The outer wall finishes off 4 inches below the ground, and is capped with a belting course of cut stone, 9 inches by 15 inches section. All the doors, on both inner and outer fronts, have cut stone sills, 13 inches by 17 inches section, the rails of track being cut into these sills, so as to give a flush surface on top, and allow the doors to fit neatly and closely. The cast iron blocks, at bases of columns of inside front, rest upon cut stone blocks 2 feet square and 1 foot thick. The outer wall above the belting course is of brick, built in panels, with pilasters both inside and out, and an ornamental outside cornice, as shown, fig. 2, plate 3. The thickness of brick in panels is 13 inches, and on pilasters 22 inches. Two of the panels are occupied by entrance doors; the balance have windows, two in each, except that there is a small door, 4 feet 8½ inches opening, in one of the panels, taking the place of a window. A flush arch is built in the wall on the inside over every pair of windows, to provide against any injury to the cornice or roof, in the event of accident to the wall below from locomotives. The entrance doors are 3½ inches thick, panaled as shown, fig. 2, plate 3, and have a clear opening in width of 11 feet 1½ inches. They are furnished with wickets, or small doors, to allow persons going in and out easily, without opening the large doors. These doors are hung on heavy cast iron hinge blocks, built into the brick work, there being three wrought hinges to each door. The windows have 4 feet 8½ inches by 9 feet 11 inches opening in brick work, the outside sills and lintels being of cast iron. They have box frames, and two flights of sash, six lights each, of 12-inch by 18-inch glass, and are double hung with cord, weights and pullies.

The inner front of the building is of cast iron, the metal being 7-16 inch thick, except, for the columns, which are ⅝ inch metal. The doors have a clear-opening in width of 11 feet 1½ inches, and are 3 inches thick, paneled and glazed as shown, fig. 3, plate 3, so as to afford an abundance of light. Three of these doors have wickets. All of the doors are provided with inside turning bars to fasten them when shut, and hooks to secure them in place when open.

The floor joist are 3-inch by 12-inch white oak, placed 15 inches apart from center to center for half the extent of each section, and 12 inches from center to center for the other half. They are cambered 1 inch at the outer wall, and proportionally less as they get shorter in approaching the inner front. The joist are laid upon 3-inch by 12-inch white oak wall plates, and they have one course of lattice bridging on the center line of each section. The flooring is double, consisting of, first, 1-inch white pine sub-flooring, worked to a thickness and laid close, and then on this, 2 inch white pine floring, worked, tongued and grooved. The rails are laid upon 3-inch by 12-inch white oak track stringers, cut into the floor joist, the top of stringer being laid flush with top of joist. A small gutter runs along each rail and drains into the pit, see fig. 6, plate 3.

The roof truss is constructed on the triangular system, of wrought iron, having a space of 64 feet 6 inches from center to center of bolt holes in heel blocks, an inclination of rafter of 22½ degrees from the horizontal, and a raise in tie rod in center of span of 6 inches above a horizontal line in the extremities. The diameters of the tension rods are given in the drawing. The rafter is a 6-inch I-beam, weighing 40 pounds per yard, and the struts and heel blocks are of cast iron. The heel block on the inner front is firmly fixed to top of column; that on the on the outer front rests upon rollers on a cast iron bed plate, a wall plate of white oak, 4 inches by 17 inches by 5 feet long, being laid under the bed plate on the brick wall. This arrangement allows of free expansion and contraction, owing to changes of temperature. The arrangement of purlins is shown on drawing, plate 2. They are of white pine, 4 inches by 8 inches and 4 inches by 10 inches, and are secured to the rafter by a wrought iron angle piece and clip, one arm of the angle piece being bolted to the purlin, while the clip passes over the arm and around the upper flange of the I-beam which forms the rafter. The purlins are cambered on the external circle, and made concave on the internal circle of the roof, so as to avoid hips and valleys and allow the roof covering to be laid evenly. On the purlins is laid roof sheeting of 1-inch worked white pine boards. The sheeting is covered with the best quality slate, from the Peach Bottom quarries of Pennsylvania. On the outside roof the slate run 11 inches and 10 inches by 20 inches, laid to weather 8¾ inches, with the exception of nine courses from the ridge, which are 9 inches by 18 inches, laid to weather 7¾ inches. On the inside roof the slate are 8 inches by 16 inches, laid to weather 7 inches. Gutters of double cross roofing tin run around the eaves of inside and outside fronts, to receive the drainage from the roof. To protect this tin from the action of destroying agents in the atmosphere, it is well painted on the under side with two coats of red lead in oil, before putting on, and afterwards, on the upper side with one coat of the same, over which the finishing colors are laid. From the gutters a 4-inch eave pipe runs down the outside wall on every alternate pilaster of the brick-work, discharging into a sewer which goes entirely around the the building, and a 3-inch eave pipe runs down the inside front on every alternate column, between the hinges at the back, discharging by a small box drain into the pit sewer.

Water plugs, with standard hose attachment, are placed in the floor in alternate stalls, and are protected by cast iron covers level with the top of the floor. These plugs are supplied by a 4-inch cast iron main pipe, passing under the floor of the building. Hydrants and wash sinks are provided at necessary points. In every section, against the outside wall, is a work-bench and vise, with the necessary tools for any slight work required on the locomotive. The building is warmed in winter by large cast iron stoves, the pipes from which pass into the smoke flues already described as provided in the roof for locomotives. To retain the heat as much as possible within the building, the stalls of the entrance tracks are separated from the balance of the house by partitions extending from the floor to the roof, and in winter the roof ventilators are closed. A small building is connected with the locomotive house, as shown on plate 1, by a projection from one of the panels, for the purpose of preparing sand for use of locomotives. It contains a large, shallow cast iron pan built over a furnace, for drying the sand, and two apartments, one for receiving it when fresh, and the other to store it when dry.

Between the locomotive house and turn-table, the rails of the track are laid with white oak cross-ties, 6 inches by 8 inches, imbedded in stone ballast 14 inches deep. The turn-table, manufactured by William Sellers & Co., of Philadelphia, is 50 feet in length, and may be described as follows: A cast-iron, rectangular box, resting upon a central pivot, which is provided with Parry's anti-friction conical rollers, has projecting from it four cast-iron, horizontal arms, in pairs, two on each side. Near their outer extremities, the arms in each pair are connected by a cast-iron strut, in each end of which, on the under side, is a wheel. These wheels are suspended just above a circular track below. Upon the horizontal arms, cross-ties of white oak are placed, and on these the rails of the turn-table track are laid. Fig. 7, plate 3., gives a section through the central box, showing the pivot and arrangement of the anti-friction rollers. The rollers and the plates between which they work are made of steel, and are very durable. The center pivot is placed upon an exceedingly firm stone foundation, 6 feet square, and capped with a single cut stone 5 feet 6 inches square and 1 foot 3 inches thick. The circular rail is laid upon white oak cross-ties, below which is a substantial stone foundation extending out far enough to sustain a 22-inch brick wall, which surrounds the pit in which the table moves. This brick wall is capped by a white oak curb, 4-inch by 13-inch section, held in place by 1-inch anchor bolts built in the brickwork. On this curb the tracks from each stall of the building terminate. The spaces between the cross-ties under the circular rail are filled in with brick laid in cement, the top surface being slightly inclined, so as to drain in the turn-table pit. The latter is paved with brick laid flat and grouted with cement. The turn-table pit drains into a main sewer which runs across, under the house, and receives the drainage from all the other sewers of the building. In each end of the table is a heavy bolt fitting into sockets in the curb, of which there is one for each track from the building. By means of these the table can be rapidly and securely fixed for any track desired. The table is set at such a height that when fully loaded, the wheels under the arms bear very slightly on the circular track. It will be noticed that no gearing is used for moving the table, it being entirely unnecessary. When unloaded, a weight of only 1½ pounds attached to the outer end of one of the arms by means of a cord passing over a pulley, will move the table. When fully loaded with locomotive and tender, properly balanced, the table may be readily moved by one man. He is provided with an iron bar, one end of which fits to the bolt previously spoken of. He walks along the curb, pushing by means of this bar, and when he arrives at the desired track, immediately drives the bolt home, securing the table where wanted.—*Journal of the Franklin Institute.*

MISCELLANEOUS.

—At a meeting held in Augusta, Me., in July, 1845, to consider the building of a railroad from Portland to Augusta, Mr. George Evans made a speech, in which he said that probably, on account of the severity of their winters, the road could not be operated more than 290 days each year. The estimate of Colonel Long, the Engineer, was only 200 days.

—The Grand Trunk Company has had one passenger coach constructed for its Detroit Division at the shops at Fort Gratiot (two miles north of Port Huron). Heretofore it has been necessary to pay duty on cars made at the company's Canada shops, or to buy them ready made at shops in the United States. It is believed that all cars for this division will be made at Fort Gratiot hereafter, which, indeed, is well situated for such work, wood of most kinds being plenty and cheap.

—Jay Cooke and C. C. Coffin ("Carleton") set forth the advantages of the Northern Pacific Railroad bonds as an investment, to the heavy men of Hartford last week, and clinched their arguments with a banquet.

—Pullman cars are to run over the Vermont Central in a line between Easton and Montreal.

—An engine on the Baltimore & Ohio Railroad exploded, near Piedmont, last Monday, instantly killing R. McClurg, the fireman, and slightly scalding the engineer.

PUBLISHER'S ANNOUNCEMENTS.

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WANTED—A position as Master Mechanic by a manwho has had twenty years' experience. References will be furnished upon application at the RAILROAD GAZETTE office.

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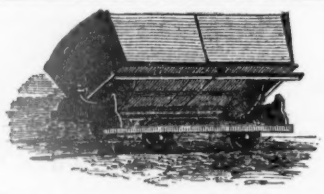

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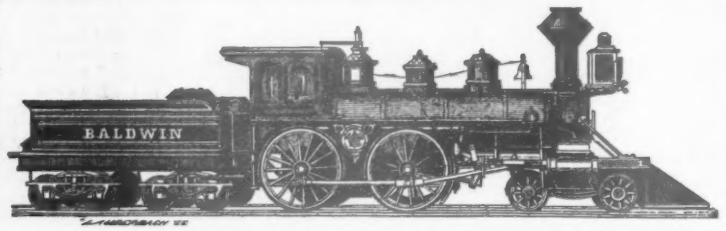

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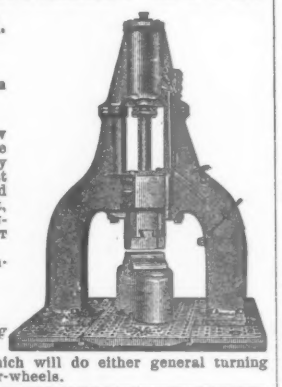

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NOTICE TO CONTRACTORS.

Proposals will be received at the office of Capt D. W. WELLMAN, Chief Engineer, at Menasha Wis., until

Twelve o'clock Noon, on Wednesday, March 1st, 1871,

for the Grading, Masonry and Bridging on that portion of the Wisconsin Central Railroad lying between Doty Island and the Wisconsin River at Stevens' Point, a distance of about sixty-four (64) miles.

Proposals will be received for the work in each Section (of about one (1) mile), or for the whole work; but parties making proposals for the whole will be required to specify the prices for work on each Section.

Blank forms, setting forth the different items for which proposals will be received, will be furnished on application; and Plans, Profiles and Specifications can be seen on and after Monday, January 23d, at the office of the Chief Engineer, and at the office of the undersigned, in Ogden Building, corner Clark and Lake streets, Chicago, Ill., on and after Monday, February 6th, 1871.

Proposals, accompanied by Plans, are also invited for the Construction of the Railroad Bridge across Wolf River—to be either of Wood or Iron —consisting of one span of one hundred and fifty (150) feet, and one draw of sixty (60) feet, clear space. The bridge to be first class in every particular, and able to meet the requirements of a first-class road.

Separate proposals will also be received for the whole of the Span Bridging on the above-described work

Right is reserved to reject all bids not deemed advantageous to the Company.

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CHICAGO, January 18, 1871.

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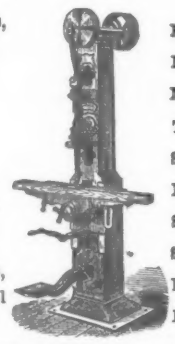

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SNOW'S PATHFINDER

RAILWAY GUIDE

CONTAINS THE TIME-TABLES

Of all New England Roads. Published under authority of the R. R. Superintendents.

MONTHLY, WITH WEEKLY SUPPLEMENT.

$2.50 per annum. 10 cts. single copy.

GEO. K. SNOW & BRADLEE, Publishers

NO. 5 LINDALL STREET, BOSTON.

KANSAS CITY TO SOUTHWESTERN KANSAS.

THE SHORTEST ROUTE

IS VIA THE

Leavenworth, Lawrence,

— AND —

GALVESTON R. R. LINE.

Two Distinct Lines of Railway from Kansas City, Mo. & Lawrence, Kan.

UNITING AT **OTTAWA**, AND FROM THENCE A **TRUNK LINE** TO

INDIAN TERRITORY!

Passing Through the Finest Towns and Traversing the Richest Portion of this Splendid State.

TWO DAILY PASSENGER TRAINS EACH WAY,

Making Close Connection at Kansas City with all Roads East,

And at **THAYER**, (Southern Terminus), with

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For WICHITA, SANTA FE and TEXAS.

500,000 Acres Choice Farming Lands!

FOR SALE UPON THE MOST REASONABLE TERMS.

This Road also Passes through the Best Portion of the

Celebrated Osage Reservation!

NOW OPEN FOR SETTLEMENT.

Ask for Tickets via LEAVENWORTH, LAWRENCE & GALVESTON R. R., and Save TIME and MONEY!

CHAS. B. PECK, GEN. FREIGHT & TICKET AGENT.

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Steel Elastic Car Wheel Co.

OF NEW JERSEY.

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FOR THE MANUFACTURE OF

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More than 3000 Miles now in Operation,

Demonstrating beyond question its superior working capacity, and great ability to withstand the elements. For RAILROAD LINES, connecting a single wire with a large number of Stations, and for long circuits, this wire is peculiarly adapted: the large conducting capacity secured by the copper, with other advantages, rendering such lines fully serviceable during the heaviest rains.

Having a core of steel, a small number of poles only are required, as compared with iron wire construction, thereby preventing much loss of the current from escape and very materially reducing cost of maintenance. OFFICE AMERICAN COMPOUND TELEGRAPH WIRE CO. 234 West 29th Street, New York.

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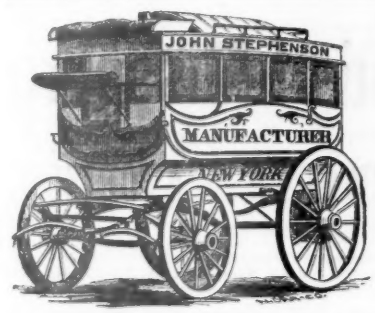

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EVERY STYLE!

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—AND—

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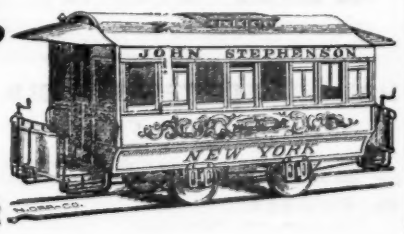

CHICAGO, ROCK ISLAND & PACIFIC RAILROAD.

☞ THE DIRECT ROUTE FOR ☜

JOLIET, MORRIS, OTTAWA, LASALLE, PERU, HENRY, PEORIA,

Lacon, Geneseo, Moline,

ROCK ISLAND, DAVENPORT,

Muscatine, Washington, Iowa City,

GRINNELL, NEWTON, DES MOINES,

COUNCIL BLUFFS & OMAHA!

CONNECTING WITH TRAINS ON THE UNION PACIFIC RAILROAD, FOR

Cheyenne, Denver, Central City, Ogden, Salt Lake, White Pine, Helena, Sacramento, San Francisco,

And Points in Upper and Lower California; and with Ocean Steamers at San Francisco, for all Points in **China, Japan, Sandwich Islands, Oregon and Alaska.**

☞ TRAINS LEAVE their Splendid new Depot, on VanBuren Street, Chicago, as follows:

	LEAVE.	ARRIVE.
PACIFIC EXPRESS, (Sunday excepted)	10.00 a. m.	4.15 p. m.
PERU ACCOMMODATION, (Sundays excepted)	4.30 p. m.	9.45 a. m.
PACIFIC EXPRESS, (Saturdays excepted,)	10.00 p. m.	[Mon. ex. 7.00 a. m.

ELEGANT PALACE SLEEPING COACHES!

Run Through to Peoria and Council Bluffs, Without Change.

☞ Connections at LA SALLE, with Illinois Central Railroad, North and South; at PEORIA, with Peoria, Pekin & Jacksonville Railroad, for Pekin, Virginia, &c.; at PORT BYRON JUNCTION, for Hampton, LeClaire, and Port Byron; at ROCK ISLAND, with Packets North and South on the Mississippi River.

☞ **For Through Tickets,** and all desired information in regard to Rates, Routes, etc., call at the Company's Offices, No. 37 South Clark Street, Chicago, or 257 Broadway, New York.

A. M. SMITH, Gen. Pass. Agent. **HUGH RIDDLE,** Gen. Supt. **P. A. HALL,** Asst. Gen. Supt.

KANSAS PACIFIC RAILWAY.

Great Smoky Hill Route

THROUGH **KANSAS** TO **DENVER,** COLORADO,

Connecting with the DENVER PACIFIC R. R. for CHEYENNE; forming, in connection with the UNION and CENTRAL PACIFIC R. R.'s, a NEW ALL-RAIL ROUTE to

Colorado, Wyoming, Utah, Montana,

NEVADA, CALIFORNIA,

AND THE PACIFIC COAST.

THE ONLY ROUTE RUNNING PULLMAN DRAWING-ROOM & SLEEPING CARS THROUGH TO DENVER.

☞ **No Omnibus or Ferry Transfer!** ☜

☞ Direct Connections made in UNION DEPOTS at **Kansas City** [State Line,] with the Hannibal & St. Joseph, North Missouri and Missouri Pacific Railroads.

☞ Daily Trains leave Kansas City, State Line and Leavenworth, for Lawrence, Topeka, Emporia, Humboldt, New Chicago, Chetopa, Junction City, Abilene, Salina, Brookville, Ellsworth, Hays, KIT CARSON, DENVER, GREELEY, CHEYENNE, OGDEN, SALT LAKE CITY, CORINNE,

Sacramento & San Francisco.

☞ Connect at Kit Carson with Southern Overland Passenger and Mail Coaches for PUEBLO, TRINIDAD, SANTA FE, and all principal points in

Old and New Mexico and Arizona.

☞ Connect at DENVER with the Colorado Central Railroad and Fast Concord Coaches, for Golden City, Black Hawk, Central City, Idaho City, Georgetown and Fair Play.

Passenger and Freight Rates as low and conveniences as ample as by any Route.

Ask for Tickets via KANSAS PACIFIC RAILWAY, which can be obtained at all principal ticket offices in the United States.

BEVERLY R. KEIM, Gen. Ticket Agt. Lawrence, Kansas. **T. F. OAKES,** Gen. Freight Agt. Kansas City, Mo. **A. ANDERSON,** Gen. Sup't. Lawrence, Kan.

FARMS AND HOMES IN KANSAS.

Five Million Acres of Choice Farming Lands, situated along the line of this Great National Route, at from one to six dollars per acre. For full particulars, apply to **JNO. P. DEVEREUX,** Land Commissioner, Lawrence, Kan.

THE ERIE & PACIFIC DISPATCH CO.

Are Authorized Freight Agents.

For information, Contracts, and Bills of Lading, apply at their office, 64 Clark Street, Chicago.

H. H. RAPP, AGT.

Western Union Railroad.

CHICAGO & NORTHWESTERN DEPOT, CHICAGO. | MILWAUKEE & CHICAGO DEPOT, MILWAUKEE.

THE DIRECT ROUTE!

CHICAGO, RACINE & MILWAUKEE,

— TO —

Beloit, Savanna, Clinton, Ft. Byron, Davenport, Mineral Point, Madison, Freeport, Fulton, Lyons, Rock Island, Sabula, Galena, Dubuque, Des Moines, Council Bluffs,

OMAHA, SAN FRANCISCO

AND ALL PRINCIPAL POINTS IN

Southern and Central Wisconsin, Northern Illinois, and Central and Northern Iowa.

FRED. WILD, Gen. Ticket Agent. **D. A. OLIN,** Gen. Superintendent.

THE FAVORITE THROUGH PASSENGER ROUTE!

Chicago, Burlington & Quincy
RAILROAD LINE.

3 THROUGH EXPRESS TRAINS DAILY!

FROM CHICAGO	Hours.	1st Class Fare.	FROM CHICAGO	Days.	1st Class Fare.
TO OMAHA, - - -	23	$20.00	TO DENVER, - -	2½	$63.00
" ST. JOSEPH, - -	21	19.50	" SACRAMENTO, -	4½	118.00
" KANSAS CITY, -	22	20.00	" SAN FRANCISCO,	5	118.00

Trains Leave Chicago from the Great Central Depot, foot of Lake Street, as follows:

BURLINGTON, KEOKUK, COUNCIL BLUFFS & OMAHA LINE

7:40 A. M. **MAIL AND EXPRESS,** (Except Sunday,) stopping at all stations; making close connections at Mendota with Illinois Central for Amboy, Dixon, Freeport, Galena, Dunleith, Dubuque, LaSalle, El Paso, Bloomington, &c.

10:45 A. M. **PACIFIC FAST LINE,** (Except Sunday,) stopping at Riverside, Hinsdale, Aurora, Leland, Mendota, Princeton, Buda, Kewanee, Galva, Galesburg, and all stations West and South of Galesburg.
☞ ELEGANT DAY COACHES and **PULLMAN PALACE DRAWING ROOM CARS** are attached to this train daily from Chicago

TO COUNCIL BLUFFS & OMAHA WITHOUT CHANGE!

9.00 P. M. **PACIFIC NIGHT EXPRESS,** (Daily, except Saturday,) for Burlington, Ottumwa, DesMoines, Nebraska City, Council Bluffs, Omaha, and all points West. **Pullman Drawing Room Sleeping Car** attached to this Train daily from **Chicago to Burlington,** and Elegant Day Coaches, from **Chicago to Council Bluffs and Omaha, without change!** This is the Route between

CHICAGO, COUNCIL BLUFFS & OMAHA,

—RUNNING THE CELEBRATED—

Pullman Palace Dining Cars!

49 MILES THE SHORTEST ROUTE BETWEEN

Chicago & Keokuk,

And the Only Route Without Ferrying the Mississippi River!

QUINCY, ST. JOSEPH, LEAVENW'TH & KANSAS CITY LINE.

7.40 A. M. **MAIL AND EXPRESS** (Except Sunday,) stopping at all stations between Chicago and Galesburg; making close connections at Mendota with Illinois Central for Amboy, Dixon, Freeport, Dunleith, Dubuque, La Salle, El Paso, Bloomington, &c.

10:45 A. M. **PACIFIC EXPRESS,** (Daily, except Sunday,) with ELEGANT DAY COACHES and PULLMAN'S PALACE SLEEPING CARS attached, running through from Chicago to KANSAS CITY, **Without Change!**

9:00 P. M. **PACIFIC NIGHT EXPRESS,** (Daily,) with **Pullman Palace Drawing Room Sleeping Car** attached running through from Chicago to QUINCY,

Kansas City, Lawrence, Topeka and Denver,

☞ WITHOUT CHANGE! ☜

64 MILES THE SHORTEST AND ONLY ROUTE BETWEEN

Chicago and Kansas City!

WITHOUT CHANGE OF CARS OR FERRY.

115 MILES The Shortest Route bet. Chicago & St. Joseph.

THE SHORTEST, BEST AND QUICKEST ROUTE BETWEEN CHICAGO AND

Atchison, Weston, Leavenworth, Lawrence,

AND ALL POINTS ON THE KANSAS PACIFIC R'Y.

Local Trains Leave
- RIVERSIDE & HINSDALE ACCOMMODATION.7:00 A. M. 1:30 & 6:15 P.M
- GALESBURG PASSENGER.....3:00 P. M.
- MENDOTA PASSENGER.....4:15 P. M.
- AURORA PASSENGER.....5:30 P. M.

Ask for Tickets via Chicago, Burlington & Quincy Railroad, which can be obtained at all principal offices of connecting roads, at Company's office, 63 Clark Street, and at Great Central Depot, Chicago at as low rates as by any other route.

ROB'T HARRIS, Gen'l Superintendent, CHICAGO.
SAM'L POWELL, Gen'l Ticket Agent, CHICAGO.
E. A. PARKER, Gen. West. Pass. Agt., CHICAGO.

THE GREAT THROUGH PASSENGER ROUTE TO KANSAS

IS VIA THE OLD RELIABLE

HANNIBAL & ST. JOSEPH
SHORT LINE.

Crossing the Mississippi at Quincy and the Missouri at Kansas City on New Iron Bridges; running Three Daily Express Trains, Through Cars and Pullman Sleeping Palaces from Chicago & Quincy to St. Joseph & Kansas City.

The Advantages gained by this Line over any other Route from Chicago, are:

115 MILES THE SHORTEST!

To St. Joseph, Atchison, Hiawatha, Waterville, Weston, Leavenworth,

64 MILES THE SHORTEST!

To Kansas City, Fort Scott, Lawrence, Ottawa,

Garnett, Iola, Humboldt, Topeka, Burlingame, Emporia, Manhattan, Fort Riley, Junction City, Salina, Ellsworth, Hays, Sheridan, Olathe, Paola, Cherokee Neutral Lands, Baxter Springs, Santa Fe, New Mexico, and all Points on the KANSAS PACIFIC, and MISSOURI RIVER, FT. SCOTT & GULF R. R's, with which we connect at Kansas City Union Depot.

THIS BEING THE SHORTEST LINE AND QUICKEST, is consequently the cheapest; and no one that is posted thinks of taking any other Route from Chicago to reach principal points in

Missouri, Kansas, Indian Territory, or New Mexico.

DAILY OVERLAND STAGES from west end Kansas Pacific Railway, for Pueblo, Santa Fe, Denver, and points in Colorado and New Mexico.

This is also a most desirable Route, via St. Joseph, to Brownsville, Nebraska City, Council Bluffs, and Omaha, connecting with the Union Pacific Railroad for Cheyenne, Denver, Salt Lake, Sacramento, San Francisco, and the Pacific coast.

Through Tickets for Sale at all Ticket Offices. Baggage Checked Through, and Omnibus Transfers and Ferriage avoided.

P. B. GROAT, Gen. Ticket Agent. Hannibal, Mo
GEO. H. NETTLETON, Gen. Supt. Hannibal, Mo.

Old, Reliable, Air-Line Route!

CHICAGO, ALTON & ST. LOUIS R. R.

SHORTEST, QUICKEST AND ONLY DIRECT ROAD TO

Bloomington, Springfield, Jacksonville, Alton,

— AND —

ST. LOUIS!

WITHOUT CHANGE OF CARS.

THE ONLY ROAD MAKING IMMEDIATE CONNECTIONS AT ST. LOUIS WITH MORNING AND EVENING TRAINS

—FOR—

ATCHISON, LEAVENWORTH, KANSAS CITY.

Lawrence, Topeka, Memphis, New Orleans,

And All Points South and Southwest.

☞ TRAINS leave Chicago from the West-side Union Depot, near Madison Street Bridge. ☜

	Depart.	Arrive.
EXPRESS MAIL	*9:15 A. M.	*8:05 P. M.
JOLIET ACCOMMODATION	*4:00 P. M.	*9:40 A. M.
NIGHT EXPRESS	†5:30 "	*12:50 P. M.
LIGHTNING EXPRESS	‡9:00 "	*7:30 A. M.

*Sundays excepted.
†Daily; Saturdays it runs to Bloomington only.
‡Saturdays and Sundays excepted. Monday mornings this train runs from Bloomington to St. Louis.

This is the ONLY LINE Between CHICAGO & ST. LOUIS RUNNING

Pullman's Palace Sleeping and Celebrated Dining Cars!

BAGGAGE CHECKED THROUGH.

Through Tickets can be had at the Company's office, No. 55 Dearborn street, Chicago, or at the Depot, corner of West Madison and Canal streets, and at all principal Ticket Offices in the United States and Canada. Rates of Fare and Freights as low as by any other Route.

A. NEWMAN, Gen. Pass. Agent. **J. C. McMULLIN, Gen. Supt.**

North Missouri R. R.

PASSENGERS FOR

KANSAS AND THE WEST,

ARE REMINDED THAT

THE NORTH MISSOURI R. R.

—IS—

11 MILES SHORTER than any other Route!

BETWEEN

St. Louis and Kansas City.

15 Miles Shorter between ST. LOUIS and LEAVENWORTH

— AND —

50 MILES SHORTER TO ST. JOSEPH!

THAN ANY OTHER LINE OUT OF ST. LOUIS.

☞ **Three Through Express Trains Daily!** ☜

Pullman's Celebrated Palace Sleeping Cars on all Night Trains!

☞ **FOR TICKETS,** apply at all Railroad Ticket Offices, and see that you get your Tickets via St. Louis and North Missouri Railroad.

JAMES CHARLTON, Gen. Pass. and Ticket Agent, St. Louis.
W. R. ARTHUR, General Superintendent, St. Louis.

Pacific Railroad of Missouri.

THE MOST DIRECT AND RELIABLE ROUTE FROM ST. LOUIS THROUGH TO

KANSAS CITY, LEAVENWORTH & ATCHISON,

☞ WITHOUT CHANGE OF CARS! ☜

Close Connections at KANSAS CITY with Missouri Valley, Missouri River, Ft. Scott & Gulf, and Kansas Pacific R'ys, for Weston, St. Joseph, Junction City, Fort Scott, Lawrence, Topeka, Sheridan, Denver, Fort Union, Santa Fe, and

ALL POINTS WEST!

☞ At SEDALIA, WARRENSBURG and PLEASANT HILL, with Stage Lines for Warsaw, Quincy, Bolivar, Springfield, Clinton, Osceola, Lamar, Carthage, Granby, Neosho, Baxter Springs, Fort Gibson, Fort Smith, Van Buren, Fayetteville, Bentonville.

PALACE SLEEPING CARS on all NIGHT TRAINS.

Baggage Checked Through Free!

THROUGH TICKETS for sale at all the Principal Railroad Offices in the United States and Canadas. **Be Sure and Get your Tickets over the PACIFIC R. R. OF MISSOURI.**

W. B. HALE, Gen. Pass. and Ticket Agt.
THOS. McKISSOCK General Superintendent.

ILLINOIS CENTRAL RAILROAD.

PASSENGER TRAINS LEAVE CHICAGO FROM THE GREAT CENTRAL DEPOT, FOOT OF LAKE ST.

ST. LOUIS AND CHICAGO
THROUGH LINE.

No Change of Cars from Chicago to St. Louis.

9:20 A. M. DAY EXPRESS Sundays Ex.
Arriving in ST. LOUIS at 10:30 P. M.

8:15 P. M. FAST LINE. Saturdays Excepted.
Arriving at ST. LOUIS at 8:00 A. M.

AT ST. LOUIS, Direct Connections are Made FOR

Jefferson City, Sedalia, Pleasant Hill, Macon, Kansas City,

LEAVENWORTH, ST. JOSEPH & ATCHISON,

—Connecting at KANSAS CITY for—

LAWRENCE, TOPEKA, JUNCTION CITY, SALINA, SHERIDAN,

Denver and San Francisco!

CAIRO, MEMPHIS AND NEW ORLEANS LINE.

No Change of Cars from Chicago to Cairo.

9:20 A. M. CAIRO MAIL, Sundays Excepted.
Arriving at **Cairo** 3:05 A. M., **Memphis** 12:45 P. M., **Mobile** 9:25 A. M. **Vicksburg** 9:25 A. M., **New Orleans** 11:05 A. M.

8:15 P. M. CAIRO EXPRESS, Except Saturdays.
Arriving at **Cairo** 12:24 P. M., **Memphis** 4:15 A. M., **Little Rock** 7:00 P. M., **Vicksburg** 8:10 P. M., **New Orleans** 1:30 A. M.

4:50 P. M. CHAMPAIGN PASSENGER,
Arriving at **Champaign** at 10:45 P. M.

☞ THIS IS THE ONLY DIRECT ROUTE TO

Humboldt, Corinth, Grand Junction, Little Rock, Hot Springs, Selma, Canton, Grenada, Columbus, Meridian, Enterprise,

MEMPHIS, VICKSBURG, NEW ORLEANS & MOBILE.

At NEW ORLEANS, connections are made for

GALVESTON, INDIANOLA,

And all Parts of Texas.

☞ **NOTICE.—This Route is from 100 to 150 MILES SHORTER, and from 12 to 24 HOURS QUICKER than any other.**

THIS IS ALSO THE ONLY DIRECT ROUTE TO

DECATUR, TERRE HAUTE, VINCENNES & EVANSVILLE.

Peoria and Keokuk Line.

9:20 A. M. KEOKUK PASSENGER, Sun. Excepted.
Arriving at **Chenoa** 3:20 P. M., **El Paso** 4:08 P. M., **Peoria** 5:43 P. M., **Canton** 7:15 P. M., **Bushnell** 8:57 P. M., **Keokuk** 11:15 P. M., **Warsaw** 11:40 A. M.

Elegant Drawing Room Sleeping Cars

ATTACHED TO ALL NIGHT TRAINS.

Spacious and Fine Saloon Cars!

WITH ALL MODERN IMPROVEMENTS, RUN UPON ALL TRAINS.

BAGGAGE CHECKED THROUGH TO ALL IMPORTANT POINTS.

☞ For Through Tickets, Sleeping Car Berths, Baggage Checks, and information, apply at the office of the Company in the Great Central Depot, foot of Lake St.

Hyde Park and Oakwoods Train.

	LEAVE.	ARRIVE.		LEAVE.	ARRIVE.
HYDE PARK TRAIN,...	*6:20 A. M.	*7.45 A. M.	HYDE PARK TRAIN,....	*3:00 P. M.	*5:15 P. M
HYDE PARK TRAIN...	*8:00 A. M.	*9.20 A. M.	HYDE PARK TRAIN,....	*6:10 P. M.	*7:35 P. M
HYDE PARK TRAIN,..	*12:10 P. M.	*1:45 P. M.			

* Sundays Excepted.

W. P. JOHNSON, Gen. Pass. Agent. M. HUGHITT, Gen. Supt.

CHICAGO & NORTHWESTERN R. W.

Comprising the PRINCIPAL RAILROADS from CHICAGO Directly NORTH NORTH-WEST and WEST.

ALL RAIL TO THE PACIFIC OCEAN!

Great California Line.

TRAINS LEAVE WELLS STREET DEPOT AS FOLLOWS:

8:30 A. M. Clinton Passenger. | **10:00 P. M.** Night Mail.
10:45 A. M. Pacific Express. | **10:00 P. M.** Rock Island Pass.
10:45 A. M. Rock Island Exp. | **4:00 P. M.** Dixon Passenger.

For Sterling, Rock Island, Fulton, Clinton, Cedar Rapids, Boone, Denison, Missouri Valley Junction, Sioux City, Council Bluffs and Omaha, there connecting with the

UNION PACIFIC R. R.

For Cheyenne, Denver, Ogden, Salt Lake, the White Pine Silver Mines, Sacramento, San Francisco, and all parts of Nebraska, Colorado, New Mexico, Arizona, Wyoming, Montana, Idaho, Utah, Nevada, and the PACIFIC COAST.

FROM CHICAGO	Hours.	1st Class Fare.	FROM CHICAGO	Days.	1st Class Fare.
To OMAHA,.....	23	$20.00	To SACRAMENTO,.	4½	$118.00
" DENVER,.....	52	65.00	" SAN FRANCISCO,	5	118.00

TRAINS ARRIVE:—Night Mail, 7.15 a. m.; Dixon Passenger, 11.10 a. m.; Pacific Express 4:15 p. m.; Rock Island Express, 4:15 p. m.; Clinton Passenger, 6:45 p. m.

FREEPORT LINE.

9.00 A. M. & 9.00 P. M. For Belvidere, Rockford, Freeport, Galena, Dunleith, and St. Paul.
4.00 P. M., Rockford Accommodation.
5.30 P. M., Geneva and Elgin Accommodation
6.10 P. M., Lombard Accommodation.
5:50 P. M., Junction Passenger.

TRAINS ARRIVE:—Freeport Passenger, 2:30 p. m., 6:40 a. m.; Rockford Accommodation 11:10 a. m.; Geneva and Elgin Accommodation, 8:45 a. m.; Junction Passenger, 8:10 a. m.; Lombard Accommodation, 6:50 a. m.

WISCONSIN DIVISION.

☞ Trains leave Depot, cor. West Water and Kinzie Sts., daily, Sundays excepted, as follows:

10.00 A. M. DAY EXPRESS, for Janesville, Monroe, Whitewater, Madison, Prairie du Chien, Watertown, Minnesota Junction, Portage City, Sparta, La Crosse, St. Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh, Neenah, Appleton, and Green Bay.
3.00 P. M., Janesville Accommodation.
5.00 P. M. NIGHT EXPRESS, for Madison, Prairie du Chien, Watertown, Minnesota Junction, Portage City, Sparta, La Crosse, St. Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh, Menasha, Appleton, Green Bay, and THE LAKE SUPERIOR COUNTRY.
5.30 P. M., Woodstock Accommodation.

TRAINS ARRIVE:—7:00 a. m., 7:15 p. m., 9:00 a. m., and 2:05 p. m.

MILWAUKEE DIVISION.

MILWAUKEE MAIL,.....	8:15 A. M.
EXPRESS, (ex. Sun.) Waukegan, Kenosha, Racine and Milwaukee,.....	9:45 A. M.
EVANSTON ACCOMMODATION,.....	1:00 P. M.
HIGHLAND PARK PASSENGER,.....	6:20 P. M.
MILWAUKEE ACCOMMODATION, with Sleeping Car attached.....	11:00 P. M.
KENOSHA ACCOMMODATION, (Sundays excepted) from Wells St. Depot.....	4:10 P. M.
AFTERNOON PASSENGER,.....	5:00 P. M.
WAUKEGAN ACCOMMODATION, (except Sundays) from Wells St. Depot.....	5:30 P. M.

TRAINS ARRIVE:—Night Accommodation, with Sleeping Car, 5:00 a. m.; Day Express, 4:15 p. m. Milwaukee Mail, 10:30 a. m.; Afternoon Passenger, 7:40 p. m.; Waukegan Accommodation, 8:25 a. m.; Kenosha Accommodation, 9:10 a. m.; Evanston Accommodation, 3.30 p. m.; Highland Park Passenger, 7.55 p. m.

PULLMAN PALACE CARS ON ALL NIGHT TRAINS.

THROUGH TICKETS Can be purchased at all principal Railroad Offices East and South, and in Chicago at the Southeast corner of Lake and Clark Streets, and at the Passenger Stations as above.

H. P. STANWOOD, Gen. Ticket Agt. **JOHN C. GAULT,** Gen'l Supt.

Milwaukee & St. Paul R. W.

THE ONLY ALL RAIL LINE TO

ST. PAUL AND MINNEAPOLIS!

AND ALL PORTIONS OF

Wisconsin, Minnesota & Northern Iowa.

PURCHASE TICKETS VIA MILWAUKEE.

Passengers Going via Milwaukee,

Have Choice of Seats in Clean Coaches, and on Night Trains, a full night's rest in Palace Sleeping Cars.

☞ BAGGAGE CHECKED THROUGH BY THIS ROUTE ONLY! ☜

PASSENGERS FROM CHICAGO can obtain these Advantages only by he MILWAUKEE DIVISION of the CHICAGO & NORTHWESTERN R'Y.

SPECIAL NOTICE.—Passengers destined to any place in Wisconsin, Minnesota, or Northern Iowa, either on or off the Lines of this Company, who cannot procure Through Tickets to their destination, should purchase their Tickets **TO MILWAUKEE,** as this is the Great Distributing Point for these States.

A. V. H. CARPENTER, Gen. Pass. Agt. Milwaukee. **S. S. MERRILL,** Gen. Manager, Milwaukee

LAKE SHORE
— AND —
MICHIGAN SOUTHERN R.W.

THE GREAT THROUGH LINE BETWEEN

CHICAGO, BUFFALO & NEW YORK,

WITHOUT CHANGE!

AND THE ONLY RAILWAY

RUNNING PALACE COACHES THROUGH!

— BETWEEN —

CHICAGO & NEW YORK, via BUFFALO

☞ WITHOUT TRANSFER OF PASSENGERS! ☜

All Trains Stop at Twenty-Second Street to Take and Leave Passengers. Baggage Checked at that Station for all Points East.

4 EXPRESS TRAINS DAILY, [Sundays Excepted,] Leave Chicago from the New Depot, on Van Buren St., at the head of La Salle Street, as follow

5:30 A. M. MAIL TRAIN.
VIA OLD ROAD AND AIR LINE. SUNDAYS EXCEPTED.

Leaves 22d Street 7:45 A. M. Stops at all Stations. **Arrives**—Cleveland, 9:35 P. M.

9:00 A. M. SPECIAL NEW YORK EXPRESS,
VIA AIR LINE. SUNDAYS EXCEPTED.

Leaves—Twenty-Second Street, **9:15 A. M.** **Arrives**—Elkhart, 12:45 P. M.; Cleveland 9:45 P. M.; Buffalo, 4:10 A. M.; New York, 7:00 P. M.; (Chicago Time) Boston, 11:45 P. M.

This Train has PALACE SLEEPING COACH Attached, Running

THROUGH TO ROCHESTER, WITHOUT CHANGE!

IN DIRECT CONNECTION WITH

Wagner's Celebrated Drawing-Room Coaches on N. Y. Central R. R.

Only Thirty-Three Hours, Chicago to New York!

5:15 P. M. ATLANTIC EXPRESS (Daily),
VIA OLD ROAD.

Leaves—Twenty-Second Street **5:30 P. M.** **Arrives**—Laporte, 8:10 P. M. (Stops 20 minutes or Supper): arrives at Toledo, 2:50 A. M.; Cleveland, 7:25 A. M. (20 minutes for Breakfast); arrives at Buffalo, 1:50 P. M.; Rochester, 5:10 P. M. (20 minutes for Supper); connects with **Sleeping Coach running Through from Rochester to Boston Without Change,** making but **One Change between Chicago and Boston.**

NEW AND ELEGANT SLEEPING COACH Attached to this Train, Running THROUGH from CHICAGO TO NEW YORK WITHOUT CHANGE! Arrives at NEW YORK, 7:15 A. M.

9:00 P M. NIGHT EXPRESS
VIA AIR LINE. (DAILY EXCEPT SAT. & SUN.)

Leaves—Twenty-Second Street, **9:15 P. M.** **Arrives**—Toledo, 6:15 A. M. (20 minutes for Breakfast); arrives at Cleveland, 10:50 A. M.; Buffalo, 5:50 P. M.; New York, 12:00 M.; Boston, 3:50 P. M.

KALAMAZOO DIVISION.

Leave Chicago 9:00 A. M. Arrive at Kalamazoo 4:10 P. M.; Grand Rapids, 7:10 P. M.

Leave Chicago 9:00 P. M. Arrive at Kalamazoo 7:25 A. M.; Grand Rapids, 10:15 A. M.

☞ There being no heavy grades to overcome, or mountains to cross, the road bed and track being the smoothest and most perfect of any railway in the United States, this Company run their trains at a high rate of speed with perfect safety.

☞ Travelers who wish to SAVE TIME and make SURE CONNECTIONS, purchase Tickets via

LAKE SHORE & MICHIGAN SOUTHERN R'Y.

THE ONLY LINE RUNNING THROUGH BETWEEN CHICAGO AND BUFFALO, WITHOUT TRANSFER, and in Direct Connection with NEW YORK CENTRAL RAILROAD and ERIE RAILWAY.

General Ticket Office for Chicago, No. 56 Clark Street.

CHAS. F. HATCH,
General Superintendent, CLEVELAND, OHIO

F. E. MORSE,
General Western Passenger Agent, CHICAGO.

GREAT CENTRAL ROUTE!

SPEED! COMFORT! SAFETY!

MICHIGAN CENTRAL
— AND —
Great Western Railways.

THE FAVORITE ROUTE, VIA NIAGARA FALLS, TO

NEW YORK, BOSTON,

AND ALL EASTERN POINTS.

Pullman's Drawing-Room Cars

FROM CHICAGO TO NEW YORK WITHOUT CHANGE.

CELEBRATED HOTEL CARS FROM CHICAGO TO ROCHESTER.

Passenger Trains leave Chicago from Depot, foot of Lake Street, as follows: (All Trains Stop at Twenty-Second Street Station to receive and leave Passengers.)

5:40 A. M. MAIL TRAIN, Sundays Excepted.
Has a car attached from Chicago going over both Main Line and Air Line Division, Without Change. Connects at New Buffalo for St. Joseph; at Jackson for Lansing, Saginaw and Bay City.

9:00 A. M. NEW YORK EXPRESS.
(SUNDAYS EXCEPTED.) Arrives at Michigan City at 11:10 A. M.; Niles, 12:20 P. M. [Dinner]; Kalamazoo, 2:10 P. M.; Marshall, 3:24 P. M.; Jackson, 4:30 P. M.; Detroit, 6:55 P. M. [Supper]; London, 11:25 A. M.; Hamilton, 2:35 A. M.; Niagara Falls, 4: A. M.; Rochester, 7:10 A. M. [Breakfast]; Albany, 2:00 P. M.; NEW YORK, **7:00 P. M.**; Springfield, 7:40 P. M.; BOSTON, **11:45 P. M.** This Train connects at ROCHESTER with

Wagner's Drawing Room Car through to New York without change!

Connects at Kalamazoo direct for Grand Rapids, Muskegon, Whitehall, &c., &c.

9:30 A. M. CINCINNATI & LOUISVILLE EXPRESS
(SUNDAYS EXCEPTED.) **Through Cars to Indianapolis and Cincinnati without Change.**

4:10 P. M. Kalamazoo, St. Joseph and Three Rivers Accom.
(SUNDAYS EXCEPTED.) Arrives at New Buffalo at 7:05 P. M.; St. Joseph, 8:40 P. M.; Kalamazoo, 1:05 P. M.; Three Rivers, 10:00 P. M.

5:15 P. M. ATLANTIC EXPRESS.
Leaves Daily. ☞ Arrives at Michigan City at 7:18 P. M.; Niles, 8:30 P. M. [Supper]; Kalamazoo, 10:40 P. M.; Jackson, 1:10 A. M.; Detroit, 3:45 A. M.; London, 8:35 A. M. [Breakfast]; Hamilton, 11:40 A. M.; Niagara Falls, 1:30 P. M.; Buffalo, 3:20 P. M.; Rochester, 5:10 P. M.; Albany, 1:30 A. M.; NEW YORK, **6:40 A. M.**; Springfield, 6:40 A. M.; BOSTON **11:00 A. M.** A MAGNIFICENT

PULLMAN DRAWING-ROOM SLEEPING CAR

IS ATTACHED TO THIS TRAIN DAILY, FROM

CHICAGO TO NEW YORK CITY.

☞ The Celebrated **HOTEL CAR** is also Attached to this Train from **CHICAGO** to **ROCHESTER.**

☞ **SPECIAL NOTICE.**—Boston and New England Passengers will please notice that thi Train now makes a direct connection through. A **Sleeping Car** is attached at Rochester at 5:30 P. M., running through to Springfield, Mass., thus avoiding transfer at Albany. Breakfast at Springfield. This Train reaches Springfield early enough second morning to CONNECT WITH ALL TRAINS up and down the Connecticut

6:30 P. M. CINCINNATI & LOUISVILLE EXPRESS
(SATURDAYS EXCEPTED.) **Through Sleeping Cars to Louisville without Change.**

This is the Only Line Running Sleeping Cars to Louisville!

9:00 P. M. NIGHT EXPRESS. Saturdays and Sundays Excepted
☞ Arrives at Michigan City at 11:03 P. M.; Niles, 12:25 A. M.; Kalamazoo, 2:00; Marshall, 3:12; Jackson, 4:25; Grand Trunk Junction, 7:00; Detroit, 7:45; London, 1:45 P. M.; Hamilton, 4:35; Toronto, 9:35; Niagara Falls, 5:40; Buffalo, 7:15 P. M.; Rochester, 9:10; Syracuse, 12:25 A. M.; Rome, 1:55; Utica, 3:25; Albany, 6:30 A. M.; NEW YORK, **12:00 M.**; BOSTON, **3:30 P. M.**

A PULLMAN PALACE SLEEPING CAR

Is attached to this Train for **DETROIT.** This Train connects at **DETROIT JUNCTION** with **Grand Trunk Railway** for

MONTREAL, OGDENSBURG, &c.

9:00 P. M. Grand Rapids Express.
(SATURDAYS AND SUNDAYS EXCEPTED.) Arrives at Grand Rapids at 9:50 A. M.

An Elegant Pullman Sleeping Car

IS ATTACHED TO THIS TRAIN

THROUGH TO GRAND RAPIDS WITHOUT CHANGE!

Connecting there Direct to MUSKEGON, WHITEHALL, &c., &c.,

SPECIAL NOTICE.—The GREAT WESTERN RAILWAY of Canada have during the past summer, put down 140 miles of New Rail, (a large proportion of the same being Steel Rails,) and otherwise improved their track, so that it can be truly said that it is in as good condition as any Line in the country.

☞ **Through Tickets** (and secured accommodations in Drawing-Room Sleeping Cars) can be purchased in Chicago at **60** Clark street (under Sherman House); at **48** Clark street (Grand Trunk Railway); at **53** Clark street (N. Y. C. R. R.); at office under Briggs House; at Great Central Depot, and at

General Office in Tremont House Bock.

H. E. SARGENT,
Gen. Sup't M. C. R. R.

W. K. MUIR,
Gen. Sup't Gt. W. R'y.

HENRY C. WENTWORTH,
Gen. West. Pass. Agt. M. C. & Gt. W. Ry